Tracking smartphone's with mobile SMS technology as dietary data collection method: A case study in Lynge School.

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Abstract

Objective: The present study investigates the feasibility and challenges using tracking smartphone devices and mobile SMS technology in dietary data collection. And conducting in practical setting among students from 7th and 9th grade students in Lynge School to explore their eating behavior in relation with available foodscapes.

Methods: Data were collected using three methods; Questionnaire, tracking smartphones and mobile SMS survey. Questionnaire included two parts, student's socio economic status and their dietary patterns (food buying place and eating food items) during lunchtime. Tracking smartphones were through installing three devices in three food outlets available in school foodscapes. MAC addresses and mobile numbers received form participant students were filtered in the web control operational system. Tracking data were extracted and collected from log files only during lunchtime. Mobile SMS survey was conducted in two system: online and collectively. Web control operating system visualized online MAC addresses and instant SMS questions were sent individually or collectively through web control operational system regarding their purchasing and eating behavior. Data were analyzed in SPSS using correlation, and general linear model.

Result: The result indicated the association between gender and class in bringing foods from home or going out during lunchtime. 9th grade boys would go out to buy pizza from outside food outlets whereas 7th grade students bring food form home more often. Correlation between questionnaire, tracking and SMS data was not significance, which indicated less accuracy in response from students in questionnaire and tracking and mobile SMS survey. But the use of tracking as method for data collection was discussed in the paper.

Conclusion: This study investigated the need of policy in macro system, from school administration in selling food in canteen to change the dietary habits among students. Additionally, despite of some practical challenges of using tracking smartphones with SMS technology, it can be used as an effective tool in collecting dietary data with certain precautions. Furthermore, more study is needed in order to invent validate and reliable of using tracking and SMS technology as method in data collection.

Table of Contents

Abbreviations

BMI: Body Mass Index

EBRBs: Energy balance related behaviors

EnRG Environmental Research Framework for weight gain prevention

ESM Experience Sampling Method

GPS Global Positioning System

GIS Geographical Information System

QUT Queensland University of Technology

SCT Social Cognitive Theory

MAC Media Access Control

WLAN Wireless Local Area Network

List of Figures

List of Tables

Thesis Overview

The framework of this paper is organized as sections.

Section 1 presents introduction to the subject matter with the problem statement and research questions that provides the aim of the study. Together existing literatures are reviewed and based as the point of departure of the subject.

Section 2 explains the use of theoretical framework of this study, where theories are presented to understand the subject problem in their point of view.

Section 3 presents the methodology of this study. Also includes the theoretical working principals of smartphone's tracking with SMS and practically piloted this method to collect data in this study.

Section 4 encompasses the results of this study.

Finally, **Section 5** presents discussion of the findings, from the questionnaire and outlines the potential benefits and challenges of smartphones tracking with SMS survey.

1.0 Introduction

The increasing rate of overweight and obesity is an epidemic problem, and the number is even growing every year. In Denmark, prevalence of overweight among women is 14.8%, where as men is 15.6% (Nordic council of minister, 2012). Overweight and obesity causes many health risk such as, diabetes, coronary diseases and other heart related diseases (Tirosh et al, 2011). The physiological effect of obesity is explained as because of overconsumption of high-energy dense food, the blood glucose level is high in the body and to store that glucose, insulin level is produce. With constant increase in glucose level elevates the increase in production of insulin. Overload of production of insulin cause type-2 diabetes. Similarly, there is high prevalence of occurring other diseases as high blood pressure, coronary heart diseases as stroke, liver and gall bladder diseases (Kopelman, 2007). In order to reduce the prevalence of overweight/obesity, it is important to change lifestyle of an individual, by reducing consumption of high-energy dense food with high intake of fruits and vegetables and increasing physical activity (Kopelman, 2007).

The causes of obesity are complex (Fox et al, 2009). Many researchers explored genetic as biological, and nutritional imbalance caused by over consumption of high energy (Lakshman, 2012) but the focus nowadays has been shifted towards the environmental surrounding of the resident (Papoutsi et al, 2011; Casey et al, 2011). The view upon childhood obesity has been shifted towards the neighborhood building environment and increasing numbers of food outlets around every neighborhood surrounding (Powell et al, 2011; Chen et al, 2012). This cluster of increasing number of food outlets is highly prominent among school environment (Crawford et al, 2007; Day & Pearce, 2011).

School children are highly vulnerable with this epidemic problem, obesity (Holsten et al., 2011; Ogden et al., 2014). With the increase in number of food outlets, the availability and accessibility of fast food restaurants and fatty foods around school environment is increasing and students are more expose to these kinds of food (Davis & Carpenter, 2009). Due to the fact that students are more time in school (Sztainer et al., 2005), there is high likely that students consume those foods during their break times. Therefore, it is important to examine the relation between dietary pattern and

food environment around school environment to understand the problem of obesity among students.

The traditional methods of self monitoring dietary assessments tools at individual level, such as food frequency questionnaire, 24-hr recall and food records, have broadly used by researchers and nutritionists as successful tools to track food consumption (Kolodziejczyk et al, 2012; Wharton et al., 2014). But self-reported dietary data is discussed as one of the limitation as social biases (Wang et al., 2007; Fox, et al, 2009) due to issue of accuracy, inconsistency of self-reported information (Wharton et al., 2014). With the development of technology, there has been change in the way researchers practices in dietary data collection. The traditional methods of dietary assessments have been changing innovatively with the invention of portable devices, which made easier to study spatial correlation between physical environment and food behavior (Wharton et al., 2014). Smartphones as an innovative invention for its everyday use as communicating media and checking online stuffs, it has also been easier for researchers to study human's food choices behavior (Huage et al., 2011) in any location. Smartphones provide opportunity for researchers to track the behavior of individuals with the different features installed in the smartphone devices such as GPS (Doherty et al, 2014), Wi-Fi and Bluetooth (Versichele et al., 2012) and scanner can used to track smartphones.

The aim of this case study was to examine the potential use of smartphone's for studying spatial analysis of human movement with SMS mobile survey to investigate the dietary habits, highlighting as a method with data collection and presenting corresponding result.

1.1 State of Art
This chapter elaborates the initial problem of this thesis, the environmental surrounding influence eating behavior among students. Reviewing the existing knowledge and analyzing the geographical studies with relation to the school food environment will be the focus of this section. Subsequently, understanding the gravity of the problem obesity and prevalence of occurring the epidemic with relation to the increasing number of food shops around the school is taken as the point of departure.

1.1.1 Dietary issues among children

Table 1, is the comparison between present dietary intake of Danish adolescences from aged 4-14 years and the dietary recommendation from Nordic ministers Council. The trend shows clearly the consumption of saturated fat and added sugar among children is higher than the NNR recommendation (Nordic council of minister, 2012). Similarly, the consumption of dietary fibers, whole grain, fruits and vegetables and fish is lower than the recommendation. This pattern of dietary consumption from the table directly reflects the dietary consumption from fast foods outlets (Poti et al. 2014).

With the increase in fast food and other convenience stores around the home (Laska et al, 2013) and school environment, there has been change in dietary pattern among students. The dietary qualities among school adolescents are decreasing (He, et al., 2012) in consumption of fruits, vegetables, milk but increase in consumption of energy dense foods, salt and drinks (Fraser et al, 2008; Clark et al, 2014). Similarly food consumed from fast food outlets will minimize the chance of reaching the recommended values as shown in table 1.

Nutrients and Foods	Actual Intake 4/7-14 years[1]	Danish/Nordic Recommendation[2]
Total Fat (E%)	35	25-35
Saturated Fat (E%)	14	Max 10
Protein (E%)	14.5	10-20
Carbohydrate (E%)	49	50-60
Added Sugar (E%)	11	<10
Dietary Fiber (g/MJ)	2.3	3.0
Whole grain (g/MJ)	62	75
F&V (g/day)	176,5	400/600
Fish (g/week)	108.5	200
Sodium (g/day)	3.8	2.4

Table 1: Dietary intake of Danish children aged 4-14 years compared with Nordic recommendation dietary guidelines.

[1]average calculation of boys and girls (DTU Fødvarerinstituttet, 2014), [2]NNR recommendations (Nordic Council of Ministers),

Staten Institut for Folksundhed (SIF, 2014) had also investigated the eating trend among student outside school environment in Denmark. This showed the increasing trend among students eating from fast food outlets during lunchtime. In the same study, in between aged 11-15 years old, schoolgirls and boys, shows that over 40% students knew that there are more than two fast food restaurants near school environment (Rasmussen et al, 2014). It was also found that 7% of girls and 12% of boys aged 11 yrs. whereas 12% of girls and 22% of boys aged 15 yrs. eat fast food twice a week (SIF, 2015). The increasing number of students eating outside school environment with increasing age shows the seriousness of the problem.

Different factors might affect the food choices among children, factors like socio-economic status (Hannah & Chen, 2013; Bouthoorn et al., 2014), eating in presence of peers and friends (Salvy et al., 2012), parental level of education (Matthiessen et al., 2014), and parents pattern of food consumption (Krömker et al, 2015). However, more discussion about the factors affecting food choice is described in the theoretical framework section.

1.1.2 Geographical Information System (GIS)

This is computer-based system for managing and analyzing spatial data, and used to design to bring together spatial data for diverse source into a unified database creating digital map. The large number of scientific papers use GIS program in studying the location by visualizing problem and analyzing through maps (Bonham-Carter & Graeme, 2014). Most of the studies used GIS software in finding the geographical information like places vulnerable to earthquakes (Bonham-Carter & Graeme, 2014), Potential places for biomass and sites for bio plants (Hôhn et al., 2014), but public health scholars have also used to investigate the link of obesity and overweight and the environmental structure of availability of energy dense foods (Day & Pearce, 2011; He et al., 2012; Stark et al., 2013; Griffiths et al. 2014; Virtanen et al., 2015).

1.1.3 Neighborhood and Buffer

Various scholars define neighborhood in various ways, but buffer provides understanding exact meaning of neighborhood (Lyseen et al., 2015). Buffer creates a circular area at a specific Euclidian distance, which helps to create easy understanding

of the area for all subjects. Most of the researchers used the buffer as a walking distance from the place as school or home or office in order to study the environmental but few tried to use buffers for car users and bickers (Burgoine, 2014). The most common used buffers for studying school environments and the cluster of fast foods outlets are 400 m to 800m but also few studies done, 1500m as walking distance of 10-12 minutes (Day & Pearce, 2011).

1.1.4 Availability of food outlets in neighborhoods

Over past years, there has been increase in number of fast food outlets around different neighborhood. Most of the articles found the association between socio economic status of neighborhood and availability of fast food outlets. The density of fast foods restaurants were more likely to be located in neighborhood with low socio economic and disadvantage areas compared with high socioeconomic neighborhood in other studies from Brazil (Duran et al, 2013) Burns, France (Smoyer-Tomic et al, 2008) and Australia (Inglis, 2007) was found the availability healthy food outlets, supermarkets, grocery stores were found high in advantage or neighborhoods in high socioeconomic status (Burns, & Inglis, 2007). The distribution of fast food outlets were found to be significant and greater exposure to low socio economic neighbourhood because of the low rent, less competitive retail market, and less restrictive land rules regulation (Smoyer-Tomic et al, 2008; Stark et al., 2013).

But the result was found to be different in Copenhagen, Denmark. There was positive association between the number of fast food outlets and socio economic factor. Lower the socioeconomic status, lesser the number of fast food outlets in those areas. But this study excluded non-tradition fast food (Café, Kiosks) from fast food categories (Svastisalee et al, 2011). Similarly, longitudinal study from US showed no difference in density of food outlets in both neighborhoods but convenience stores were found more in neighborhood with low socioeconomic status (Richardson et al., 2014).

1.1.5 Obesity and School food environment:

The densities of fast food outlets were high around school surroundings as well. A study done in five urban region schools across New Zealand shows that the availability of high numbers of food outlets and convenience stores around the school

environment in walking proximity (Day & Pearce, 2011). Another longitudinal study in UK shows the increase of fast food takeaways and convenience stores in buffer of 400m (Smith et al., 2013). This increase in number of fast food outlets and other convenience stores were identified as obesogenic environment (promoting obesity), because of availability of poor dietary foods (He et al., 2012; Burgoine, 2014). With the increase in obesogenic environment around different neighborhood foodscapes, there was high probability of consuming less fruits and vegetable but more energy dense foods and drinks (Davis & Carpenter, 2009) and was directly associated with increasing Body Mass Index (BMI, which is an indicator to measure obesity level among individuals) result in obesity (BMI>25kg/m^2) (Nordic council of Minister, 2012). A cross-sectional study conducted among US public school, revealed different food outlets are widely available in the public school environment and were selling high consumption of calories and low-nutrient, which was associated with increase in BMI (Fox et al, 2009).

Foods in the fast food outlets and convenience store sold in low price, and were low in nutrients and high-energy foods. Low socioeconomic status students were more likely to purchase low price foods compared to high price healthy foods (Hannah & Chen, 2013; Drewnowski et al, 2014), and were associated with increasing prevalence of obesity (Wang et al., 2007). Similarly, the study from Finland (Virtanen et al., 2015) showed similar finding. The presence of fast food outlets near school was positively associated among adolescence with low socioeconomic status accumulation with skipping breakfast and free school lunch eating habits and were in greater risk of overweight

In contrast, a study in Marine US showed no significance relation between food-stores near school environment selling high calorie dense and high school obesity risk (Harris et al., 2011). Author discussed the reason for no significance could because of the study area, as vast majority of schools in rural area did not have fast food outlets in buffer of 2km. Similarly other study in UK showed no significance association with food outlets (categorized as supermarket, retail and fast foods retail stores) and children obesity (Griffiths et al., 2014). This article argued as healthy food can be bought in all the food outlets. Therefore it is necessary to measure what foods has been purchased and consumed by the children.

1.1.6 Spatial tracking studies:

Many researches have shifted their focus towards tracking place and human movements in predicting human's social behavior. Traditionally, human behavior was viewed mostly in only location like home or work but the complexity of the mobility and connectivity of people; the focus has been shifted to individual/people-based view (Mikkelsen et al, 2012). In past Surveys and video Surveillances were the most common used methods in monitoring customer's behavior in one location. But with the high cost and different issues concerning weather condition, density and crowd, created difficulties during data collection (Versichele et al, 2012; Abedi et al, 2013). But with the invention and popularity of smartphones, it motivated researchers to collect large data in different locations. Due to smartphone's multitasking ability as portable information system, communication technology, and other applications, the use of smartphone is large in most parts of the world (Oulasvirta et al., 2011). Additionally, various other technologies are embedded into smartphones such as, GPS (Global Positioning System), Bluetooth, Wi-Fi, MAC address (Media Access Control), WLAN, cellular antenna, cameras, etc., (Pei et al, 2013). Smartphones are also mostly practice due to its ability to design different application and used on different purposes. Application could also be used to track and overcome the errors of different technological systems in the smartphones (Zhu et al, 2013). With all this technologies and abilities in the smartphones, it has been an attractive device among researchers in most of the spatial studies tracking individual devices. Bluetooth has also been applied in tracking in closer proximity due to its short coverage ability whereas GPS is used in outdoor at mass events (Versichele et al, 2012) due to wide coverage with accuracy (Pei et al, 2013).

The ability of developing application software on smartphones was used in some studies in providing information to participants in doing interventions. Application software has been used as persuasive guidance in randomized controlled trial study for obesity prevention intervention among low-income adolescence boys (Smith et al, 2014). Although there was no significant effect on participant's body composition but there was improvement in muscular fitness, muscular skills and weight related behaviors.

Similarly to explore the physical movement and the qualitative responses of the participants one of the study designed an application in smartphones where questionnaire survey about individual's experience, feeling, and health were included (Doherty et al., 2014). It was an effective method to track people's behavior in the natural environment. The GPS function of smartphone has been used to track the participants. This study suggested the method of using application collaborating GPS could be used as a method in collecting human experiences and health impacts as data.

But there have been many issues and concern about the privacy linked with smartphones because of daily use for different purposes as, email, banking, contacts, documents. One of the functions to the smartphones users is being online to check different online stuffs, but keeping the programs always online can lead to excessive leakage of private data (Huage et al., 2011). But not much information has been discovered in affecting the leakage of private information from the smartphones like mails, banking and others (know as hacking) by knowing the MAC addresses despite the movement (Cunche, 2014). Nevertheless tracking the human movement of high-profile individuals (Cunche, 2014) can be controversial issues despite of many potential benefits in understanding human behaviour as for concern parents about their children movements, emergency response to lost or injured person (Sopher, 2012).

Summary:

With the above literatures, it is clear that the problem of obesity is rising especially among school students. Due to the increasing numbers of fast food outlets around the school environment, and availability and accessibility of high-energy dense food, there is high prevalence of obesity among school students. Since, school children are more time in school. But other different factors could influence in the consumption of food from fast food outlets. Therefore it is necessary to know the dietary pattern of students and places where students buy foods.

Thus this study examines the use of smartphones' MAC addresses tracking to investigate the preferable eating-places among students during their lunchtime. Different techniques have been used in tracking methods that are found in the

different literature from above. But this study coincides with the other study done in Queensland University of Technology (QUT) in Brisbane, Australia using MAC address to investigate the human movement in the kitchen dinning area and rest room. This study suggests MAC address as an effective tool to collect human movement data either in individual or in groups in environment. Also mentions complementing MAC address data with cameras could enhance the method (Abedi, et al., 2014). However for this study mobile SMS survey is chosen to complement considering the budget, in determining the food habits among students. This study also differs from the study done by Abedi et al, since study was conducted indoor but this study is done in outer space in school environment.

2.0 Problem Statement

- **"Is the availability and accessibility of different fast food outlets and convenience store in the buffer of 1.5 km around Lynge school foodscapes affecting/influencing the eating behavior of 7th and 9th graders, aged 13-17 years?"**

- **Is smartphones tracking system is practicable to investigate students food eating behavior by tracking student's smartphones during school lunchtime".**

2.1 Research questions:

- How is the Foodscape near Lynge School and what kinds of foods are students exposed to in school foodscapes?

- What factors are affecting students eating behavior during school lunchtime?

- How feasible is to conduct tracking as a method with collaborating mobile SMS survey in data collection?

- Does those collected data provides good insight of the problem?

- Do the students' response to the questionnaire is reliable in data collection? (Questionnaire vs. tracking) (Saying vs. doing).

2.2 Delimitation

The literature review provided some guidelines about conducting this study. But all the aspects from the reviews were not possibly included in this study. Some parts were delimitated and present in this section.

- This is a case study, and study is limited in itself i.e. investigating only one foodscape in Lynge school only during lunchtime.

- Theoretical frameworks are to understand the problem through theories' point of view rather conducting its determinants during data collection.

- The study is limited to a certain time period during the day and therefore only accounts for some food intake. Therefore obesity can not be predicted but still explore the eating habits of students

- The buffers restrict the area in which the participants are tracked; no information is gathered about any activity the participants are involved in during lunchtime.

3.0 Theoretical framework

This section provides the brief explanation of the framework in describing problem of the study. The chosen problem was to examine whether availability of different fast food outlets influencing the eating behavior among students. Different theories posses different approaches but in this study chosen theories are interrelated to each other and presented below to view the problem with these theories' point of view.

3.1 Social cognitive theory (SCT):

SCT is more based on the reciprocal relation between three determinants, environmental, personal and behavioral where human thought and action are viewed as the product of a dynamic interplay of personal, behavioral and environmental influences (Bandura, 2001; McAlister et al., 2008). There is a triadic reciprocality between those determinism doesn't mean has equal strength among them (Bandura, 2001).
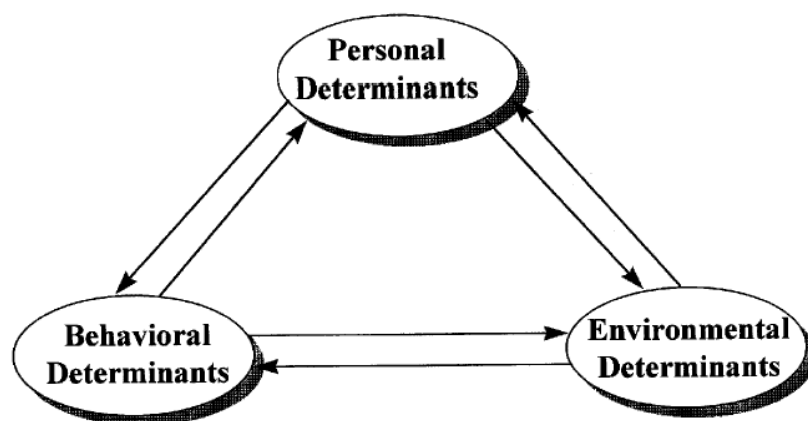
Fig 1: Social cognitive theory (Bandura, 2001)

Although SCT model has been implemented used in different behavioral studies (Yoon & Tourassi, 2014) but found to be effective in health related behavior. This model is used in health intervention by understanding the cause of the problem, mostly used in healthy dietary eating habits among adolescence students. In one of the intervention in increasing students' eating fruits and vegetables, students' personal determinants affecting behavior and serving more vegetables by teachers were seen in school areas, but the actual effect of the availability of healthy food outlets around school environment had not been investigated (Roche et al., 2012). A study examining the determinants of dietary behavior change among adolescence girls from

neighborhood in low socioeconomic status school, personal determinant were positively significant among adolescent girls with healthy eating (Lubans et al., 2012). There was no environmental determinant significant in eating habits. Similarly, other study among students from three different countries showed 65% participants students purchase foods from fast food outlets with the availability of different fast food outlets and convenience food stores in closer proximity around school environment (He et al., 2012). Therefore it is important to investigate the different factor influencing eating behavior among students. But the main focus for this study is environmental factor affecting students' eating behavior.

3.2 Ecological Model:

Ecological model was developed to understand the multiple and interacting determinants of health behaviors in changing behavior intervention. This model emphasizes the influence of environmental and policy context of behavior, incorporating the social and individual characteristics. The main core of the ecological theory is the dietary habits among students are affected and multiple levels of influences intrapersonal, interpersonal, community/institutional and macro-level/policy influences are affecting the eating behavior (Sallis et al., 2002). This model has been mostly implemented in physical activity or active living (Sallis et al., 2006) but some scholar suggested using model in healthy lifestyle (Dietary habit and physical activity) (Story, 2008).
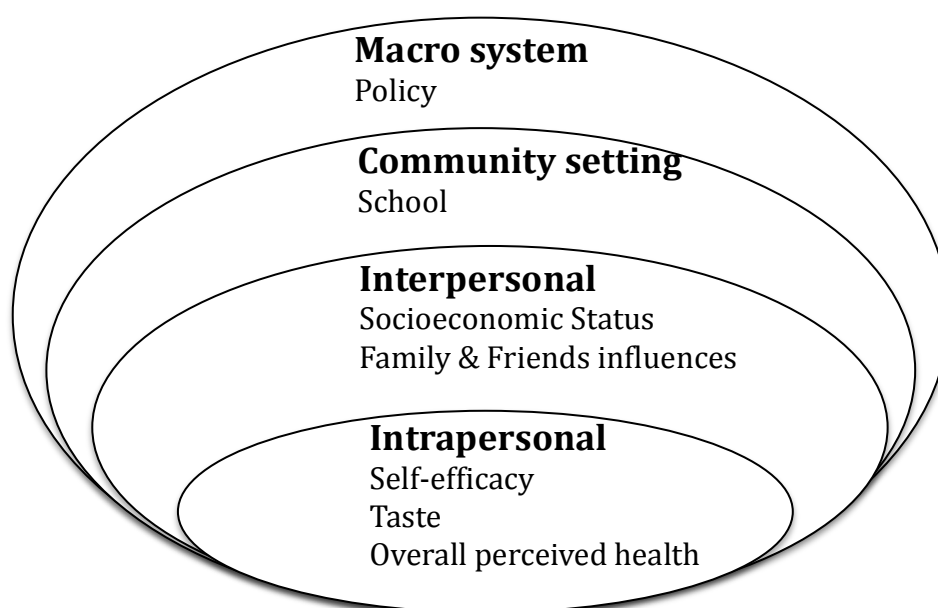
Fig 2: Overview of Ecological model in school food choice among students

Brown & Landry-Meyer (2007) studied factors in ecological model are mostly influencing high school student's food choices. This multilevel approach in health problems determined the influencing factors of the problem providing insights in making further interventions (Story et al., 2002). The case in students' school food choices showed correlation between perceived health and students' self-efficacy (Brown & Laura, 2007) as Intrapersonal variables. Similarly, socio-economic status of family influenced the eating healthy or unhealthy food. Students with low family education with low level of parental education have inverse relationship with unhealthy eating behavior (Pampel et al., 2010) as Interpersonal variables. But there was negative correlation between availability of fast food stores and students' healthier food choices (Brown & Laura, 2007). Despite of mass media advertisements and accessibility of fast food outlets, students chose food from healthier location. Perceived knowledge about impact on health due to unhealthy food could have affected the result. However the policy didn't show any significant with the scoring to meet the best nutritional standards among adolescence students but it could play an important role in changing the eating behavior among students in schools (Brown & Laura, 2007). In promoting healthy eating subsidies in healthy food and taxation on unhealthy food could decrease the consumption of unhealthy food and increases consumption of healthy food (Brambila-Macias et al., 2011).

These two theories have quiet similar concepts that human behavior is influenced by different factors such as, individual's characteristics, social factors and environmental factors. But the policy as other influencing determinants in changing human behavior sets ecological model differ from SCT. Since, policy in the social setting has high influence in changing the behavior in healthy food consumption (Streletskaya & Kaiser, 2014). Furthermore, it is important to understand eating behavior is not affect as independent effect of environment rather its causal role in facilitating students' choice and opportunities (Morland et al., 2006). Therefore different other factors can influence students eating behavior together with environmental factor. It is essential to understand the specific environment causing the behavior to occur. Dual process model briefly simplifies the occurrence of behavior among students.

3.3 Dual process:
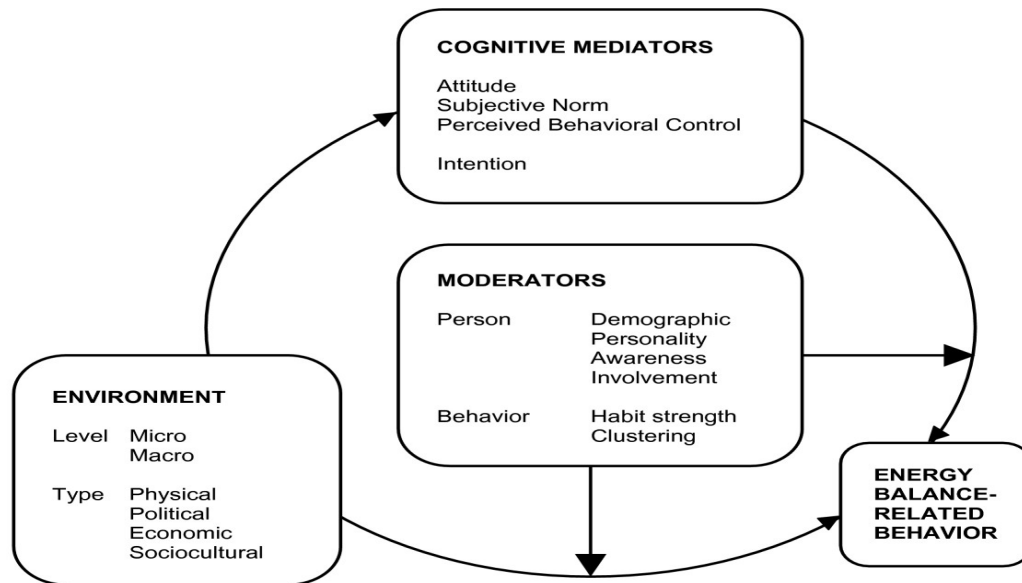
Fig 3: Environmental Research framework for weight Gain prevention (EnRG framework)

EnRG framework known as the dual-process, which describes the behavior occurs due to simulation influences of conscious and unconscious processes (Kremers et al., 2006). However most of the health behavior model focus on the reflective or conscious factors in changing the behavior (Sheeran et al., 2013). Dual process provides the understanding of different human behavior as explicit and implicit human emotions (Gyurak et al., 2011) but in this study it focuses mainly with the energy balance related behaviors (EBRBs). EBRBs are dietary habits and physical activity, contributes in energy balance but in this study used as only dietary eating habit among students. From the fig 5, various specific factors are anticipated to behavioral causal path, as environmental, cognitive mediators, individuals' moderators to behaviors. This model shows students eating behavior during lunchtime can be occurred with two different pathways. First direct pathway showing behavior occurred due to environmental factor. For instance, students could consume everyday foods from fast food outlets due to the availability of fast food outlets around school environment as automatic or unconscious. Other factors could influence them to eat or not eat foods from fast food outlets like their intention, economical status, parent's work, perceived knowledge, gender and different others as conscious process.

Furthermore this model categorizes environment in different types as physical, sociocultural, economical and political type that provides more specific environmental factors influencing behavior. The physical environment is the availability and opportunities for healthy and unhealthy food choices in environment whereas the sociocultural environment refers to social and cultural influences in occurring any behavior and similarly the economic environment represents cost in relation to healthy and unhealthy food choices, and the political environment refers to the formal and informal rules and regulation to healthy and unhealthy food choices (Kremers et al., 2006).

In these three theories, environment has found as common determinant in behavior occurrence. In the past most studies focused on the interpersonal and intrapersonal factors in occurring behavior but environment factor is also noted as cause of behavioral change among students. Especially Dual EnRG framework distinguishing environment in categories provided framework for this study to investigate students' behavior on buying foods form different places.

3.4 Foodscapes

This is an emerging term in public health, which focuses on the environmental setting of food choice in any individuals, defined as Foodscape, places and spaces where people meet food, prepare meals, understanding and analyzing the food interactions whom are engage in with the environment, with others, with food and meals, and gathering meaning as well as food-related strategies, ideas, and policies (Mikkelsen, 2012; Mackendrick, 2014). Foodscapes are the locations where food is centered in the environment that are not always the distance or proximity but is the places where an individual or groups receives or purchase foods from (Mackendrick, 2014).

In other words, foodscapes is the physical food environment in the school surrounding that has an impact on eating behavior of students. The notion of foodscapes is suited in the institutional setting i.e. out of home eating setting (Mikkelsen, 2012). Therefore, the idea of foodscape is implemented in this study to understand the students' choice of food their preferred buying place during lunchtime, due to presence of different food outlets in the Lynge school environment.

There were seven different food outlets in school foodscapes, together with school canteen, two pizzerias (Rey's and Pappas), two supermarkets (Netto, super brugsen), one cafeteria and Chinese restaurant. The information about the food outlets was gathered from Google map and field visit. But cafeteria and Chinese restaurant were excluded due to their opening time (from 1500 everyday). Therefore, with our assumptions and information received from the teachers from the school about student's chance of going during their lunch break to eat food, we discovered other location as Rey's Pizzeria, Super brugsen, Netto and Pappas Pizzeria as school's foodscapes. Fig 4 shows is the digitized view of foodscapes around Lynge School and study location developed using GIS system.
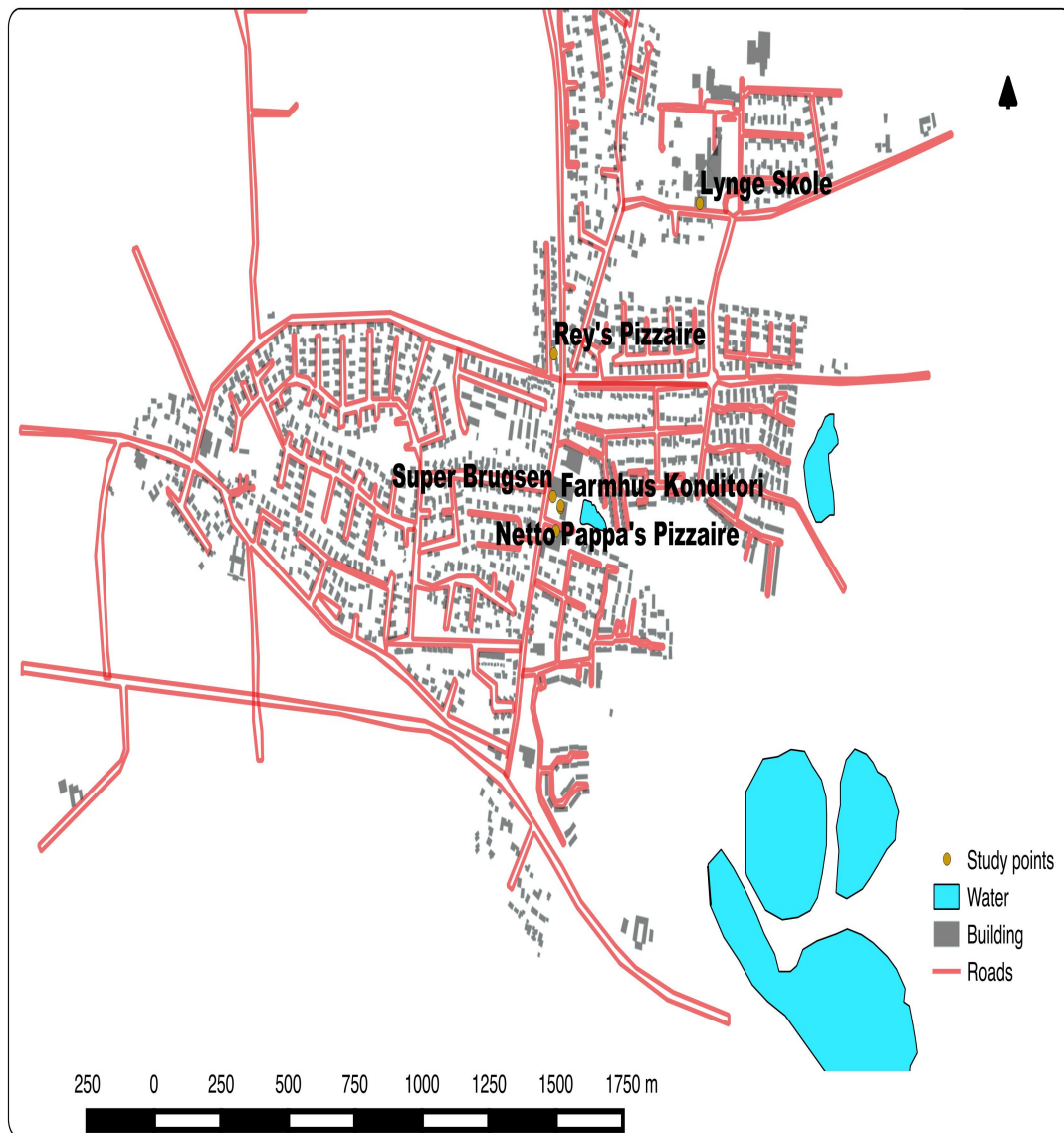
Fig 4: Geographical location of the study area using QGIS software.

This is a case study in Lynge skole to investigate student's eating pattern/movement, where they bring/purchase foods during their lunch break. Brief description about Lynge School is presented below:

Lynge School is a public school with 781 total students from 0-9th grade. School opened from 8:00 am to 14:30. Every lecture was about 45 minutes long. There were two small breaks (10 minutes) after two lectures and one lunch break at 11:20 to 12:00 (40 minutes) during the day. The purpose of this study was to examine the eating behavior of students only during lunch break around 40 minutes. Lunchtime is considered the most essential time because of the midday eating time among students. Also, the time for lunchtime was considered enough to go out and buy foods from outside food outlets. The shops were around 12 minutes distance away from the school within buffer of 1200 m. However most students bike to come to school. So, 1200m were taken as buffers in this study because of the assumption that students possibly bike to go and eat from outside food outlets during their lunch break.

For this study, 7th and 9th graders students were selected, due to the fact that students were allowed to leave school during lunch break from 7th grades. Since students from 7th grades were the one experiencing the new feeling of going out of the school. And we assumed that the flow of students going out could be more in this group than 9th grade students. But together with that, it could be 9th grades as everyday behavior going out and eating foods from outside food outlets during their lunchtime. We assumed that flow of 9th grade students could also be seen because of their daily habit going out during their school lunch break.

School canteen was a private canteen. Canteen opened from 9:00 am to 12:00 am. Students were allowed to buy foods from canteen during short and lunch breaks. Foods found in the canteen were Pizza, meatballs, pasta salad, Pizza breads, biscuits, concentrate juice, burger and raw apple. Everyday there was something special for students and usually written in the board in front of the canteen. The picture below shows the menu for week 13 and 15 of 2015. But the foods were mostly fast foods.
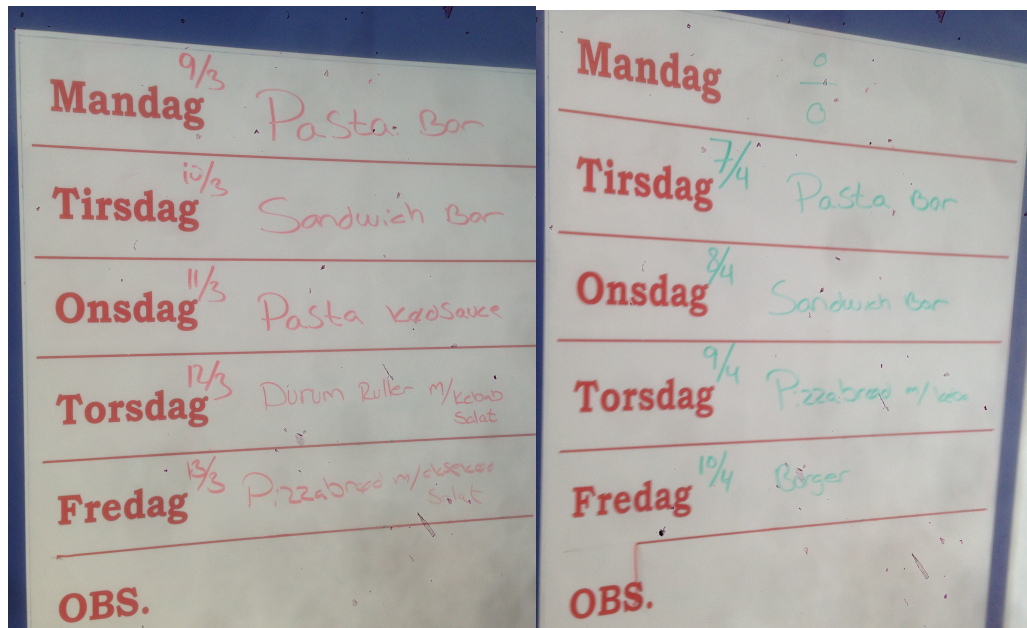
Fig 5: Food board in Lynge school canteen on week 13 and 15

The rough food assessment was done in other places as well and presented in the questionnaire to investigate the food intake among students (Appendix). Most of the food items students would be quick or ready-made foods like pizza and burger from Pizzeria. Other foods supermarkets could be fruits and vegetables, chips and bakery products. All the food items students would mostly eat during were reviewed lunchtime (Christensen et al, 2013).

4.0 Methodology

4.1 Theoretical working principal of "Tracking device"

The tracking system is based on the simple fact, as there are lots of airwaves transmitted by Wi-Fi devices. The Wi-Fi network works into two frames; 1) Data frames and 2) Management and control frames. Data frames carries actual data traffic from mode to the receiver while management and control serves associations, authentication and service discovery. If the data frames are encrypted, header (which is the information about the device) can be received. MAC address is also in header list (Cunche, 2014). MAC address known as media access control is a unique hardware number of a device with 12 digits hexadecimal numbers. It is found as 10:3A:9X:5C:89:4E, in smartphone devices. Mac addresses are statics and permanent in the device. The purpose of this number is to communicate with other device found on a same network (Mac addressing, 2015).

A feature in Wi-Fi technology as service discovery, allows stations to discover the access points (APs) in range, where active and passive service discovery co-exist. Passive service discovery periodically send their beacons frames containing information like MAC address, while stations passively listen to those beacons to discover APs in range. While in active service discovery, stations plays an active role in periodically searching the devices with probe request frames to which AP respond with probe response frame. That means the smartphones searches for network to which it has been previously connected. But in case of connection between stations and devices without matching or exchanging the probe requests, devices still periodically broadcast their MAC address. That means it can create situation during connection between stations and devices information exchange where their information do not match, in this case as well MAC address is periodically broadcasted (Cunche, 2014). Therefore, in both active and passive serving discovery, there is clear broadcasting of MAC address, which can be tracked online by the tracking devices. It is important to note that all manufacturers and telephones beacons frames behave in same ways. Some send beacons relatively often, while other practically does not send any beacons.

The other approach in this method was collaborating SMS survey together with MAC address to examine the instant behaviour among students. MAC addresses were online and could be clutched in the operational system, and immediately, SMS questions were able to send.

4.1.1 Experimental design:

A tracking device called BeagleBone Black rev. C with Linux Debian operating system was used in tracking MAC addresses for this study. It has capability of scanning devices up to 10 m without using any external antenna. The fig. 6 below shows the hardware components used in this experiment to collect data.
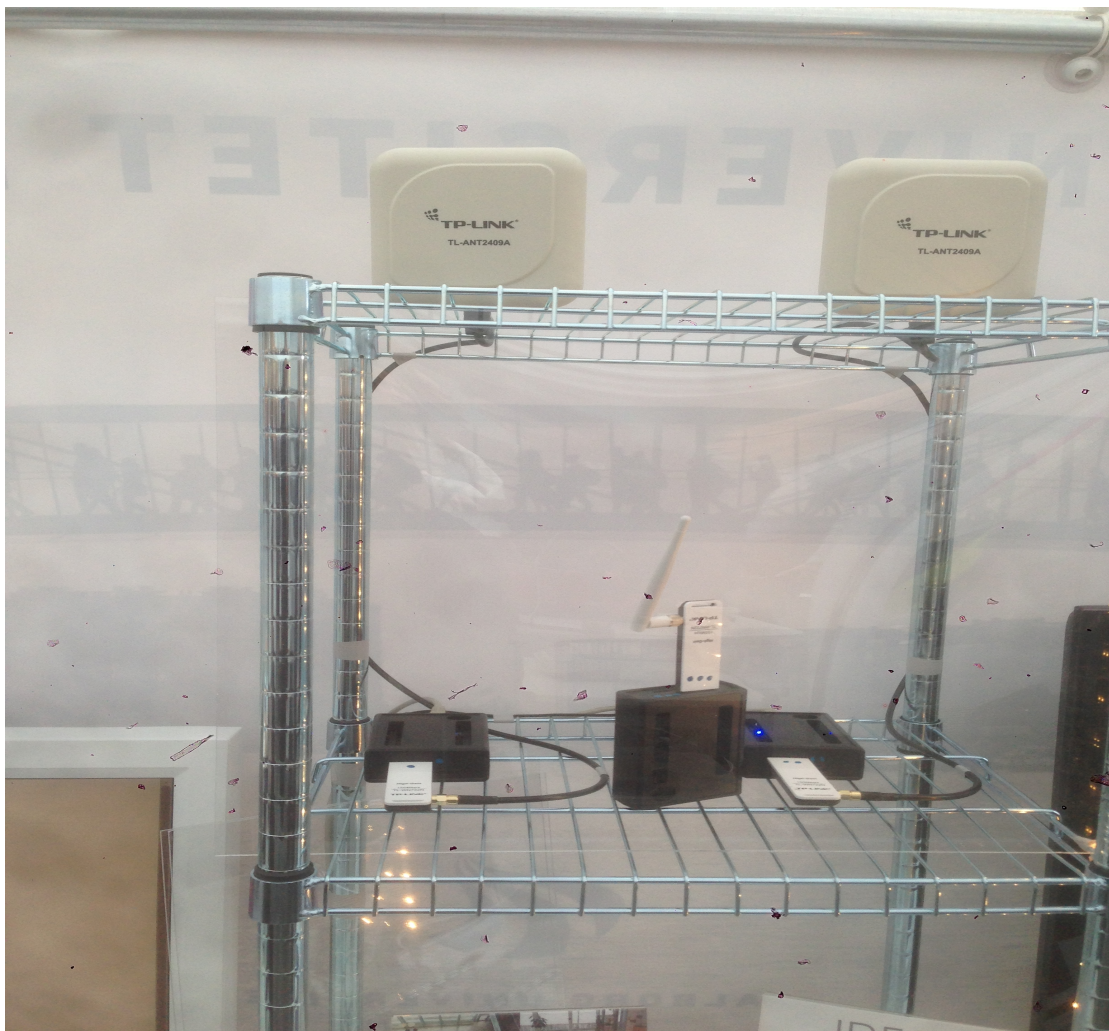
Fig 6: BeagleBone Black rev. C with Linux Debian operating system with antennas.

The system was designed to be always online to determine the time duration. The central server has been created as web control panel that enables setup of embedded

computers, data collection and monitoring of the systems. In order to protect privacy of people no involve in the project, the setup active filtering of MAC addresses was done using python systems, i.e. filtering only the beacons that we are interested in, all others were discarded.

The passive serving discovery had been used in this experiment, where the web controls system listens only those beacons sent by the registered MAC addresses. In fact communication between operating system and in the central server was of course encrypted. Because of the security reasons no data stored on each system - configuration and provisioning was online. As soon as the system was disconnected/or software restarted, the original filtering MAC lists was lost. The web control system was operated to view the detection of students' MAC addresses as online is https://secure.syscore.dk/widetect/filters, where authentication had been used. MAC addresses and mobile numbers were registered in the web control link. The fig. 2 illustrates the online status of MAC addresses.

Fig 7: The online status in Central control (Web); Green colour indicates operating system is online and have detected detect many MAC addresses; Red colour indicates the system is offline.

Online status was also used to send SMS survey, which was other aim of the study. in fig 7, green ID colour represents the owner of MAC address has been detected online

in that location. The were two possible mode in sending mobile questions, one through web-control server to all the filtered MAC addresses registered with mobile numbers and the other when the MAC addresses were detected online by the operating system via centred mobile number. The mobile number where SMS responses are collected is centred mobile number.

4.2 Description of study area

The study was conducted in Lynge, which is located in Allerød municipality, Denmark. The Municipality is in the heart of Northern Zealand with 24,000 residents (Allerød commune, 2015). It is approximately 30 km away from Copenhagen city. It is a part of capital region. Fig 8, represents the annual budget of different regions in Denmark. It shows that Capital region (Hovedstaden) has high budget compare to others regions of Denmark and the economical status of this Municipality is high (Municipalities and regions, 2015).
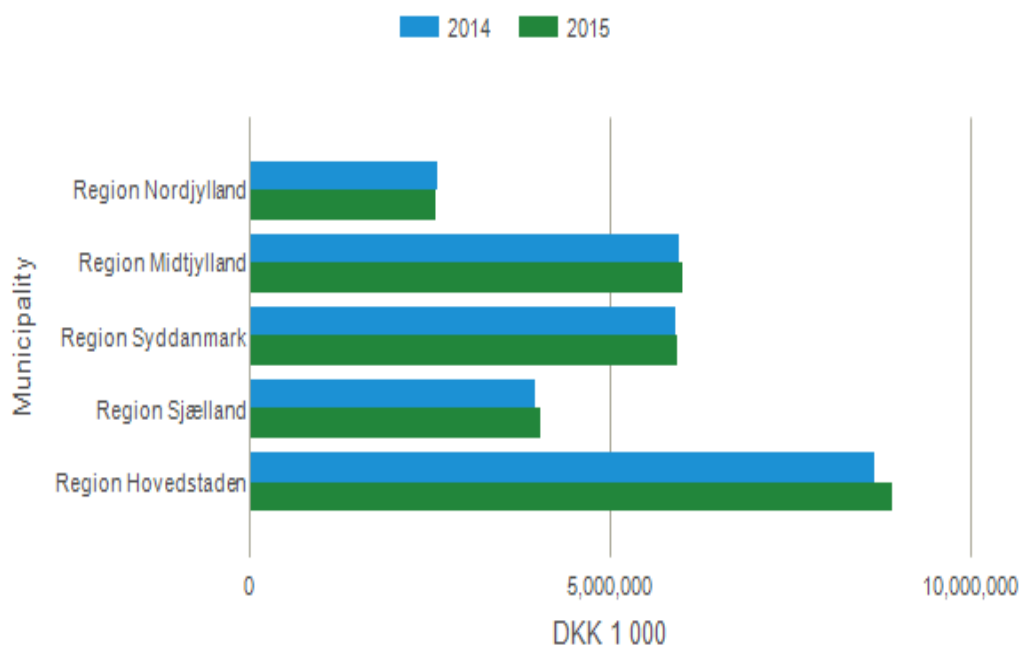
Fig 8: Budget comparison of five different regions of Denmark.

4.3 Method

In this study, the data collection was done through three different methods, questionnaire, tracking device and SMS mobile survey. This aim of this study was to develop method in collecting data through tracking devices and SMS technology. But

tradition method as questionnaire is also conducted to investigate eating pattern among students. Questionnaire response could also used to examine "saying" as questionnaire response whereas tracking and SMS data were considered as student's actual behavior as "doing". This can be discussed whether SMS could be the real action but because of the instant reply of the behavior, it is consider as "doing". But self-stated could consider bias in someway whether saying or doing actual action. However this study will explore how reliable is self-reported data comparing "saying" vs. "doing" in their eating pattern.

The numbers of students from 7th and 9th grades were 156. It is not surprising that all the students from 9th grade have smartphones whereas around 90% from 7th grade. But out of 156 students, parental-signed informed consents were obtained from 64 (41%) students. The study was voluntarily and ethical consideration was carefully applied during the studies. Since one of the objectives of this study was to track student's smartphones without using student's name. And due to fact that conducting electronic research could create issues and concern specially in smartphones, ethical consideration has to be use clearly. Therefore, parental permission was essential and asked their children participation for this study. Students were anonymous and voluntary. But questionnaire was distributed in the classroom with teacher's permission. All students were asked to fill the questionnaire and to answer all the questions as possible. Students were informed not to write their names but those who were allowed to participate in the tracking were asked to write their MAC addresses. But it was not mandatory, which later lacked the information during analyzing the data because of less MAC addresses written in the Questionnaire.

Only 29 students with parental signed permission letter were found matched in the questionnaire. Therefore only 29 data were analyzed with tracking and SMS survey during "saying" vs "doing" analysis. Four responses from SMS survey were not included because of students chose to reply SMS via their mail id.

4.3.1 Questionnaire
The study was done in the Danish public school. Thus, the questionnaire was prepared in Danish language. Questionnaire was divided in two measuring parts; 1) family

socio-economic status, 2) students eating habits in lunchtime with their morning and dinner food choices.

Questionnaire was Pilot tested among 8th grade students since they were not included in the study. Certain changes were done afterwards. The option "less than or once a week" didn't make sense to 8th graders. (If calculation is done per week and the sum should be 5 than it should be specific). Therefore for the study it was changed to only "once a week". Similarly, in one of the question about student's opinion on school canteen foods, "Neutral" option was not used before so most responses was found good. But when asked among students they think it's not good but they still buy the food because of convenience and cannot call it bad. So, "Neutral" option was used afterwards in the question. Also one more question was added in the questionnaire in relation to the opinion on school canteen food. And opinion was coded to categorize Neutral response to either bad or good afterwards.

4.3.1.1 Socio-economic status

In order to measure socio-economic variable four different questions were asked in the questionnaire, 1) Student's birthplace ("Are you born in Denmark?" Yes=1, No=0) 2) their parent's birthplace (Which land are the adults whom you live together with are born? Text response), 3) the parental educational level (what is the highest completed education by the adults whom you live with? Not completed schooling=0, School level (0-9 Class)=1, Gymnasium education=2, Technical education=3, Professional Bachelor education=4, 5-6 years University education=5) this is merged into three categories as low level of education (0&1)=0, Medium level of education (2-3)=1, and High level of education (4-5)=3. Student's household income (How much income you households annually?, Less than 20000 kr=0, 200.000-399.999 kr =1, 400,000-649.999 kr=2, 650.000-799.999 kr=3 and more than 800.00 kr=4) (Entwisle & Astone, 1994). Teachers were instructed to inform students the income is before tax. Also, if students don't know the income, they can response by considering themselves whether they are poor, rich or middle. During analysis parental education level, household income and parental work were selected as independent variables in SPSS.

4.3.1.2 Eating habits

To examine the student's preferable buying place, question applied was "how often do you bring food from home, buy food from school canteen, buy foods from outside food outlets or don't have lunch?" (Never=0, 1-2 days a week=1, 3-4 days a week=2, 5 days a week=3). Since the numbers of responses were low and most chosen responses were never, therefore categorization provided with some results to analyze the data. Together, other questions as how often do you leave school and do you leave school to buy foods (binary variable) were asked among students in questionnaire. These questions were also used to analysis the relation with the tracking data.

To explore the dietary eating habits, different food items and frequency during school lunchtime were measured. Rough dietary food assessment in different study places were observed and used in the questionnaire. The articles were also reviewed in order to identify popular and frequently consumed food items among Danish school children (Steen and Kayser, 2009; Christensen et al., 2013). Questions as "Which food items do you buy when you buy in school or outside of school and how often?" (Never=0, once a week=1, 2-3 times a week=2, 4-5 times a week=3). To investigate the student's opinion about the school canteen food, question was asked to rate the food from canteen and why. "What do you think about food from canteen, very bad=0, bad=1, neutral=2, good=3 and very good=4) and why, to elaborate their opinion). Similarly, students eating habit, measuring different food items, in morning breakfast and evening dinner was measured to examine the daily dietary habit of the school students during schooldays.

4.3.1.3 Body Mass Index (BMI):

BMI (Kg/m^2) was calculated from students' self-reported height and weight. The categories were used as percentile range and seen CDC's (2015) website. In adolescents, underweight is defined as less then the 5th percentile whereas overweight is defined as at or above the sex-specific 85th percentile but less than the 95th percentile; obesity is defined as a BMI at or above the sex-specific 95th percentile (Ogden et al., 2012; Healthy weight, CDC, 2015).

4.3.2 Tracking operational system

Three tracking devices were installed in three different food outlets in Lynge skole foodscapes. One was installed in the school canteen whereas other two were installed in Rey's pizzeria and in super brugsen. Due to insufficient devices, there was no possibility of installing devices in other study location Netto, Pappas Pizzaira and Farmhus konditori. But these shops were located close to each other. With the tracking range up to 10 m, the device in super brugsen was kept near the glass window with high range antennas, assuming device would cover whole area (fig 4).

Tracking data were collected in Excel logfiles from three different locations, school, pizzeria, and Super brugsen. Time period was merged in such a way that lesser than 2-minute time intervals between identical MAC addresses were categorized as continuous tracking and time spent was regular. But tracking time more than 2-minutes were considered as the MAC address not been in that location continuously. And tracking time was not continous. This is more illustrated in table 2; shows the raw excel data from tracking log files. During the study on 4/10/2015 few MAC addresses were tracked for couple of times and time has been merged accordingly. For instance MAC address 10:3B:59:6E:BF:16 had been tracked frequently but the time period was less than 2 minute, therefore considered as continuous tracking despite of other MAC address (04:F7:E4:83:07:2C) in between. If that had exceeded more than 2 minutes time period (11:21:25-11:22:40) than those data would have been non continuous and were excluded.

4/10/2015 11:20:16	1	B8:C7:5D:19:29:C6	4/10/2015 11:20:25
4/10/2015 11:20:17	1	B8:C7:5D:19:29:C6	4/10/2015 11:20:27
4/10/2015 11:20:45	1	10:3B:59:6E:BF:16	4/10/2015 11:20:54
4/10/2015 11:20:47	1	10:3B:59:6E:BF:16	4/10/2015 11:20:56
4/10/2015 11:21:11	1	10:3B:59:6E:BF:16	4/10/2015 11:21:21
4/10/2015 11:21:14	1	10:3B:59:6E:BF:16	4/10/2015 11:21:23
4/10/2015 11:21:15	1	10:3B:59:6E:BF:16	4/10/2015 11:21:25
4/10/2015 11:21:38	1	04:F7:E4:83:07:2C	4/10/2015 11:21:47
4/10/2015 11:22:32	1	10:3B:59:6E:BF:16	4/10/2015 11:22:40

Table 2: Raw time detection data tracked in school canteen on 4/10/2015.

MAC addresses with continuous tracking but lesser than 4 minutes time duration were excluded. Since the time period assumed to buy foods from canteen was considered to

be 4 minutes. Furthermore, in case of Mac addresses tracked twice in same day, the first tracking time period was considered as buying foods from canteen. Out of 62 registered MAC addresses, only 32 MAC addresses were tracked in different three locations during study duration. Few addresses were tracked in different places in same day during lunchtime. The radar plot shows the frequency of 7th and 9th grade student's MAC address tracked in three different study location.

In testing the correlation between saying vs doing, tracking data was analyzed with questionnaire data on students going out to buy foods and how often students go out. The frequency was categorized as never=0 and other frequencies, 1-2 days, 3-4 days, and 5 days=1. Since, in measuring correlations between two variables, those variables have to have same scale.

4.3.3 SMS survey:

Student's mobile numbers were entered in the web control system during filtering the MAC addresses in operational system. All the messages were received in centered mobile number. In two possible modes of conducting SMS survey, web control operating system was used for three times only. Other mode in online detection of MAC address sending SMS via central mobile was done twice but there were no responses for both times by the detected students. Taking into account that the purpose of this method was to check the feasibility and students' interest in this sort of designed method. Therefore not to make students dispassionate because of lots of questions, and to receive as much response as possible, few surveys were conducted. The questions in the SMS survey was "what foods students eat" and "from where food was brought during lunchtime". Collected data were corresponded with MAC address and mobile numbers and afterwards analyze to verify "saying" vs "doing".

Similarly, response from questionnaire were converted from continuous variable to binary variables by categorizing never as No=0, whereas other frequencies (1-2, 3-4 or 5 days) were categorized as Yes= 1. Questions as "how often students go out during lunchtime to buy food", "How many days a week they buy foods during lunchtime", "whether students leave school or not" were all analyzed with the tracking frequency and Mobile survey. Correlation and table custom from SPSS were analyzed to find the correlation and frequency between "saying" from the

questionnaire and "doing" from tracking data and pivotal table was used to analyze tracking data vs. Mobile survey data.

4.4 Statistical Analysis:

In SPSS versions 22, General linear model was use to analyze the significance. Independent variables were preferable food bringing/buying place (foods from home, food from school canteen and foods from outside food outlets) analyzed with dependent variables as gender, class, parental income, and parental educational level. But BMI as independent variable was also analyzed with the preferable food bringing/buying place as independent variable to investigate the significance. Descriptive analysis was done using crosstab in SPSS.

5.0 Results:

This section presents the results of this study. In order to the answer the research questions, results encompassed two different findings. The first is the descriptive analyses of questionnaire, provides the socio demographics and trend of eating pattern among students from Lynge School. Second part provides frequencies of tracked MAC address and correlated with mobile SMS survey to explore saying vs doing using questionnaire data as well.

5.1 Descriptive analysis of Questionnaire

5.1.1 Socio demographics of students

Table 3, shows the demographical profile of the students participated in questionnaire survey. The numbers of participants were 105, where 40.5% were boys and 58.5% girls. There were 64% and 80% students' parents with high education level and both having work respectively. The reported yearly household income (41%) was more than 800,000 Dkk. Comparing BMI frequency, 85% of both boys and girls were normal and boys (10%) were higher in overweight compare to girls (4%). The opposite was the case in underweight; boys (5%) were less underweight than girls (11%).

Gender and grade	Number	%
7th Girls	30	51%
Boys	28	49%
9th Girls	32	68%
Boys	15	32%
Birthplace		
Denmark	98	93%
Not Denmark	7	7%
High parental level of Educational		
Low level of education	3	3%
Medium level of education	20	19%
High level of education	67	64%
Missing/prefer not to answer	15	14%
Parental work		
No	1	1%

Yes, only one parent	16	15%	
Yes, both of the parents	84	80%	
Missing /prefer not to answer	4	4%	
Yearly House income			
<400.000 kr	4-5	4%	
400.000kr- 649.000kr	12	12%	
64-50.000kr-799.000kr	12	12%	
>800.000kr	43	41%	
Missing/ prefer not to answer	33	31%	
BMI-Girls			
Underweight	5	11%	
Normal	40	85%	
Overweight	2	4%	
BMI- Boys			
Underweight	2	5%	
Normal	35	85%	
Overweight	4	10%	

Table 3: Socio-demographic profile of the 7th and 9th students from Lynge school

5.1.2 Foods from home, Canteen or outside food outlets

Table 4, shows the frequency of number of students who prefer to bring or buy food from home, school canteen or outside food outlets distributed with classes and gender. Out of 105 responses, total numbers of responses were 104 and one response was missing. It was discovered that in total students, 80% students never eat food bought from outside food outlets. Similarly, 66% students brought foods from home during their lunchtime. But, it was found 39% students would buy foods from school canteen at least 1-2 days. Most of the students would bring foods from their home than buying from school canteen or outside food outlets. But certain numbers of students buy from school canteen.

Grade & Gender	Frequency	Home%	School%	Outside school %	No Lunch %
7th	Never	2 (7%)	17 (56%)	28 (93%)	25 (83%)
	1-2 days	1 (3%)	12 (40%)	2 (7%)	2 (7%)
Girls (30)	3-4 days	9 (30%)	0%	0%	1 (3%)
	5 days	18 (60%)	1 (4%)	0%	2 (7%)

Boys (28)	Never	3 (11%)	14 (52%)	20 (74%)	23 (84%)
	1-2 days	0%	12 (44%)	7 (26%)	2 (8%)
	3-4 days	6 (22%)	1 (4%)	0%	0%
	5 days	18 (67%)	0%	0%	2 (8%)
9th Girls (32)	Never	2 (6%)	23 (72%)	29 (90%)	26 (81%)
	1-2 days	0%	8 (25%)	2 (7%)	15 (6%)
	3-4 days	5 (16%)	0%	0%	0%
	5 days	25 (78%)	1 (3%)	1 (3%)	1 (3%)
Boys (15)	Never	4 (27%)	5 (33%)	6 (40%)	11 (73%)
	1-2 days	2 (3%)	9 (60%)	46 (0%)	3 (20%)
	3-4 days	4 (27%)	1 (7%)	3 (20%)	1 (7%)
	5 days	5 (33%)	0%	0%	0%
Total	Never	11 (11%)	59 (57%)	83 (80%)	85 (82%)
	1-2 days	3 (3%)	41 (39%)	17 (16%)	12 (11%)
	3-4 days	24 (23%)	2 (2%)	3 (3%)	2 (2%)
	5 days	66 (63%)	2 (2%)	1 (1%)	5 (5%)

Table 4: Frequency of students trend of bring or buying foods from home or school or outside school food outlets among 7th and 9th grades boys and girls of Lynge School's.

However, there was found percentage difference among gender eating during school time. 91% of girls from both grades would never buy food from outside food outlets yet 57% of boys from both grades would buy at least 1-2 days from outside food outlets. In comparing food from home with gender, 62% girls and 50% boys would bring food from home everyday during schooldays. Likewise, comparing preferable place of bringing or buying food with grades, 84% of 7th grade and 65% of 9th grades students never eat foods from outside food outlets whereas 63% of 7th and 55% of 9th grade students bring foods from home every school day. Also, 42% of 7th and 43% 9th grade students would buy foods from school canteen 1-2 days a week. However, there were 11%, 2% and 5% students who would not eat anything during Lunchtime in school every 1-2 days, 3-4 days and 5days a week respectively.

Table 5 shows, there was significance P-values tested between foods from home as dependent variable with gender and parental level of education but was found not significant to class and income comparing p<0.05. This shows gender and class could influence student's habit of bringing foods from home.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Parental Education	3.280	1	3.280	4.383	.041
Income	1.518	1	1.518	2.029	.160
Gender	2.950	1	2.950	3.941	.052
Class	1.835	1	1.835	2.452	.123
Gender * Class	6.183	1	6.183	8.260	.006

Table 5: Food from home as dependent Variable and Gender, class, parental education and Income

The table 6 below illustrates the interception and shows the descriptive frequencies of genders and grades. 7th graders (2.56) have high frequency of bringing foods from home than 9th grade (2.31) students. The interception between gender and class was significance shows in the table not constant difference between gender and class and less frequency of 9th grade boys (1.69) compared to 9th grade girls (2.74) bringing foods from home.

	7th	9th	Total
Girls	2.50	2.74	2.63
Boys	2.61	1.69	2.23
Total	2.56	2.31	

Table 6: Frequency of students as gender and class in bringing food from home

Parental educational level was found to have an influence on students bringing foods from home. Table 7 shows the positive association on student's food bringing from home and parental level of education. But income has negative association but with not significance p-value (>0.05).

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Parental Education	.460	.220	2.093	.041	.020	.899
Income	-.189	.132	-1.424	.160	-.453	.076

Table 7: Parameter estimation of food from home as dependent Variable

In this study, frequency was also measured between genders, class with consumption of food items from the questionnaire to examine eating trend among students from 7th and 9th grade in Lynge School. Since from table 4, it was found some students buy

foods from school canteen and outside food outlets. Therefore, it is interesting to know students choice of foods from those locations.

5.1.3 School canteen

Table 8, shows the frequency of different food items consumed by students from school canteen. Food items 53% of 7th and 25% of 9th grade girls along with 69% of 7th and 46% of 9th grade boys would eat pizza from the canteen at least 1 day in a week. Similarly the consumption of apple among 7th grade girls and boys were 10% and 4% compare to 9th grade girls and boys 3% and 0% at least once a week respectively but 13% boys from 9th grade would eat apple every 4-5days a week. Correspondingly in consumption of Juice among 7th grade girls and boys were found 17% and 32%, whereas 9th girls and boys were 12% and 20% respectively. The consumption of meatballs was also realized as been consumed more by 7th grade boys (38%) than girls (17%) or 9th grade boys (7%) or girls (12%). Other food items were not consumed often or seem never from the table.

		7th		9th	
	Frequency	Girls n (%)	Boys n (%)	Girls n (%)	Boys n (%)
Pizza	Never	14 (47%)	7 (27%)	24 (75%)	6 (40%)
	1 day	16 (53%)	18 (69%)	8 (25%)	7 (46%)
	2-3 days	0	1 (45)	0	1 (7%)
	4-5 days	0	0	0	1 (7%)
Cheese bread	Never	21 (70%)	17 (65%)	23 (72%)	14 (93%)
	1 day	9 (30%)	9 (35%)	8 (25%)	0
	2-3 days	0	0	1 (3%)	0
	4-5 days	0	0	0	1 (7%)
Apple	Never	27 (90%)	23 (88%)	30 (94%)	12 (80%)
	1 day	3 (10%)	1 (4%)	1 (3%)	0
	2-3 days	0	1 (4%)	0	1 (7%)
	4-5 days	0	1 (4%)	1 (3%)	2 (13%)
Youghurt	Never	27 (87%)	26 (100%)	29 (91%)	13 (87%)
	1 day	3 (10%)	0	3 (6%)	0
	2-3 days	1 (3%)	0	0	0
	4-5 days	0	0	1 (3%)	2 (13%)
Dry fruits	Never	28 (93%)	26 (100%)	31 (97%)	13 (86%)
	1 day	2 (7%)	0	1 (3%)	0

	2-3 days	0	0	0	1 (7%)
	4-5 days	0	0	0	1 (7%)
Sandwich bar	Never	28 (93%)	21 (81%)	29 (91%)	11 (72%)
	1 day	2 (7%)	4 (15%)	3 (9%)	2 (14%)
	2-3 days	0	0	0	0
	4-5 days	0	1 (4%)	0	2 (14%)
Meatballs	Never	25 (83%)	16 (62%)	27 (85%)	12 (79%)
	1 day	5 (17%)	10 (38%)	4 (12%)	1 (7%)
	2-3 days	0	0	1 (3%)	1 (7%)
	4-5 days	0	0	0	1 (7%)
Cakes	Never	30 (100%)	19 (73%)	30 (94%)	13(86%)
	1 day	0	7 (27%)	1 (3%)	1 (7%)
	2-3 days	0	0	0	0
	4-5 days	0	0	1 (3%)	1 (7%)
Juice	Never	25 (83%)	16 (60%)	26 (82%)	10 (66%)
	1 day	5 (17%)	8 (32%)	4 (12%)	3 (20%)
	2-3 days	0	1 (4%)	2 (6%)	1 (7%)
	4-5 days	0	1 (4%)	0	1 (7%)

Table 8: Frequency of different food items consumed per week among 7th and 9th grades students in Lynge School canteen.

Similarly, table 9 shows, the significance was measured between foods bought from school canteen as dependent variables and other variables as genders, class, and income in buying foods from school canteen. Parental education was significant in buying foods from canteen $p<0.05$ but all other variables were not influencing students buying foods from school canteen.

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Parental Education	-.384	.173	-2.215	.031	-.730	-.037
Income	.163	.104	1.561	.124	-.046	.372

Table 9: Food buying form school canteen as dependent Variable

Parameter test in table 10 shows the negative association between parental level of education and students buying foods form school canteen. Parental level of education has negative influence on students' food buying in school canteen

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Parental Education	2.284	1	2.284	4.908	.031
Income	1.134	1	1.134	2.438	.124
Gender	.779	1	.779	1.675	.201
Class	.019	1	.019	.041	.840
Gender * Class	.963	1	.963	2.070	.155

Table 10: Parameter estimation of food buying from school canteen as dependent variable

5.1.4 Food from outside food outlets

Table 11, shows the food consumed from outside food outlets by 7th and 9th grade students from Lynge School. Students did not appear to consume most food items from outside food outlets during lunchtime as shown form table 3. But 7th grade students would buy more often than 9th graders foods from outside food outlets at least once a week. Unlikely, Pizza and Burger are consumed more by 9th grade boys (53%, 20%) than girls (3%, 0%) or 7th grade boys (21%, 0%), and girls (7%, 3%) once a week respectively. Comparing students buying both fruits and vegetables in average was found to be 9th grade boys (15%) 2-3 days a week compare to other groups (<3%) from outside food outlets.

		7th		9th	
	Frequency	Girls n (%)	Boys n (%)	Girls n (%)	Boys n (%)
Pizza Pitabrød	Never	28 (93%)	22 (79%)	30 (94%)	3 (20%)
	1 day	2 (7%)	6 (21%)	1 (3%)	8 (53%)
	2-3 days	0	0	0	3 (20%)
	4-5 days	0	0	1 (3%)	1 (7%)
Toast Pølse bread	Never	29 (97%)	28 (100%)	31 (97%)	13 (86%)
	1 day	1 (3%)	0	1 (3%)	1 (7%)
	2-3 days	0	0	0	0
	4-5 days	0	0	0	1 (7%)
Chicken Burger	Never	28 (93%)	28 (100%)	32 (100%)	11 (73%)
	1 day	1 (3%)	0	0	3 (20%)
	2-3 days	0	0	0	0
	4-5 days	1 (3%)	0	0	1 (7%)
Raw Vegetables	Never	26 (87%)	25 (89%)	30 (94%)	9 (60%)
	1 day	3 (10%)	3 (11%)	0	3 (20%)

	2-3 days	1 (3%)	0	0	1 (7%)
	4-5 days	0	0	2 (6%)	2 (13%)
Rye bread	Never	24 (80%)	23 (82%)	32 (100%)	10 (67%)
	1 day	3 (10%)	5 (18%)	0	1 (7%)
	2-3 days	3	0	0	2 (13%)
	4-5 days	0	0	3	2 (13%)
Fresh fruits	Never	24 (80%)	25 (89%)	31 (97%)	11 (73%)
	1 day	4 (13%)	3 (11%)	1 (3%)	0
	2-3 days	0	0	0	3 (20%)
	4-5 days	2 (7%)	0	0	1 (7%)
Chips	Never	26 (87%)	19 (68%)	31 (97%)	14 (93%)
	1 day	3 (10%)	9 (32%)	1 (3%)	0
	2-3 days	1 (35)	0	0	1 (7%)
	4-5 days	0	0	0	0
Concentrated Juice/ sodvand	Never	26 (87%)	17 (61%)	31 (97%)	10 (66%)
	1 day	4 (13%)	11 (40%)	1 (3%)	2 (13%)
	2-3 days	0	0	0	2 (13%)
	4-5 days	0	0	0	1 (7%)
Pasta salad	Never	21 (70%)	23 (82%)	30 (94%)	11 (73%)
	1 day	9 (30%)	5 (18%)	2 (6%)	3 (20%)
	2-3 days	0	0	0	1 (7%)
	4-5 days	0	0	0	0
Bakery products	Never	26 (87%)	20 (71%)	27 (84%)	12 (80%)
	1 day	3 (10%)	8 (29%)	3 (9%)	2 (13%)
	2-3 days	1 (3%)	0	0	1 (7%)
	4-5 days	0	0	2 (7%)	0

Table 11: Frequency of food from outside food outlets among 7th and 9th grade students from Lynge School

In table 12, the significance between gender with food buying from outside food outlets $p < 0.05$ and almost significance compared to class. Gender influences eating from outside food outlets. But the interception between gender and class was not significance. Also, other variables, parental educational level and income were not significant therefore have not influenced on students buying foods from outside school food outlets.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Parental education	.339	1	.339	1.035	.313
Income	.003	1	.003	.010	.922
Gender	2.616	1	2.616	7.999	.006
Class	1.164	1	1.164	3.559	.064
Gender * Class	.264	1	.264	.807	.373

Table 12: Foods buying from outside school food outlets as dependent Variable

5.1.5 Body Mass Index (BMI)

Table 13, shows no significances between BMI and students bring food from home or buying from school canteen or outside food outlets. This provides no clear suggestion on BMI and food consumed from different places among students.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Food from Outside outlets	.088	1	.088	.662	.418
Food from Canteen	.047	1	.047	.354	.553
Food from home	.052	1	.052	.390	.534
Gender	.426	1	.426	3.214	.077
Class	.220	1	.220	1.657	.202
Gender * Class	.921	1	.921	6.940	.010

Table 13: Comparing foods bringing/buying from home, School and outside food outlets with BMI as dependent variable

5.1.6 Food intake recall

The response on the question about the difficulty on remembering food consumed last week is presented on table 14, compared with gender and class. It was found that in total, 17% and 44% responded as most difficult and difficult to remember the food consumed last week, while 14% and 4% thought easy to remember. 21% students didn't like to give their opinion on the question and chose neutral as their response.

				Most difficult	Difficult	Neutral	Easy	Easiest	
7th grade	Boy or Girl	Girls	Count	4	15	4	3	3	29
			%	13.8%	51.7%	13.8%	10.3%	10.3%	100.0%
		Boy	Count	4	6	10	4	1	25
			%	16.0%	24.0%	40.0%	16.0%	4.0%	100.0%
9th grade	Boy or Girl	Girls	Count	6	16	4	2		28
			%	21.4%	57.1%	14.3%	7.1%		100.0%
		Boy	Count	2	4	2	4		12
			%	16.7%	33.3%	16.7%	33.3%		100.0%
	Total		Count	16	41	20	13	4	94
			%	17.0%	43.6%	21.3%	13.8%	4.3%	100.0%

Table 14: Remembering your food consumption of last Sunday

5.2 Tracking:

All the tracking data were collected in Excel logfiles from three different locations, school, pizzeria, and Super brugsen. Out of 62 registered MAC addresses, only 32 MAC addresses were tracked in different three locations during two weeks period. The bar chart shows the frequency of 7th and 9th grade student's MAC address tracked in three different study locations in study dates.
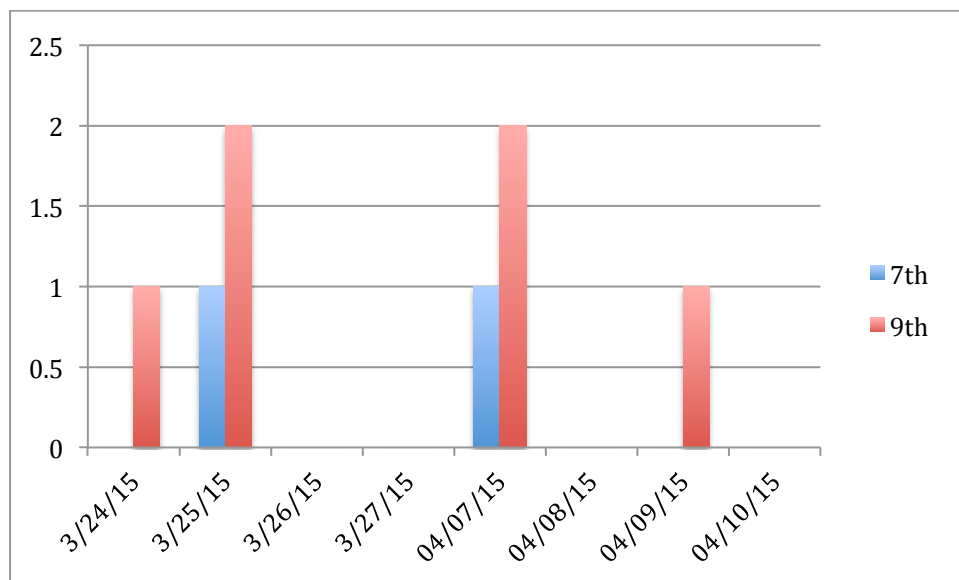
Fig 9: Bar diagram for frequency of 7th and 9th grades students tracked in Rey's pizzeria
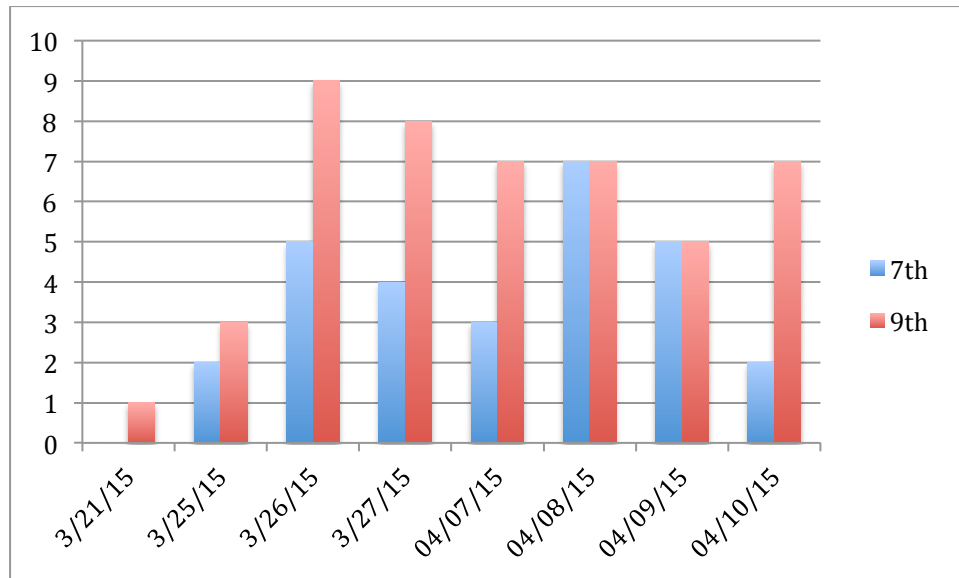
Fig 10: Bar diagram for frequency of 7th and 9th grades students tracked in school canteen
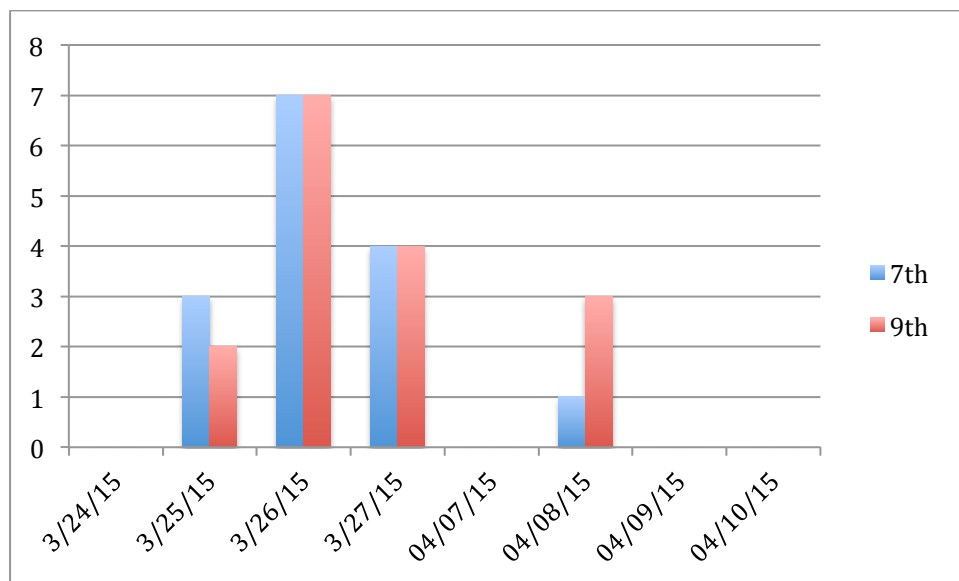
Fig 11: Bar diagram for frequency of 7th and 9th grades students tracked in Super Brugsen

From above figures (4, 6), the frequencies of 9th graders were comparatively similar to 7th grader students detected in outside school area (Rey's Pizzeria and super brugsen). Out of 8 MAC addresses tracked in Pizzeria, the numbers of MAC addresses tracked were 6 from 9th graders and only 2 students from 7th grades (fig 4). Similarly, large numbers of MAC addresses from 9th graders (47) were detected in school canteen than from 7th grades (28) students (fig 5). But nearly equal numbers of MAC (15 & 16) addresses were detected in super brugsen (fig 6).
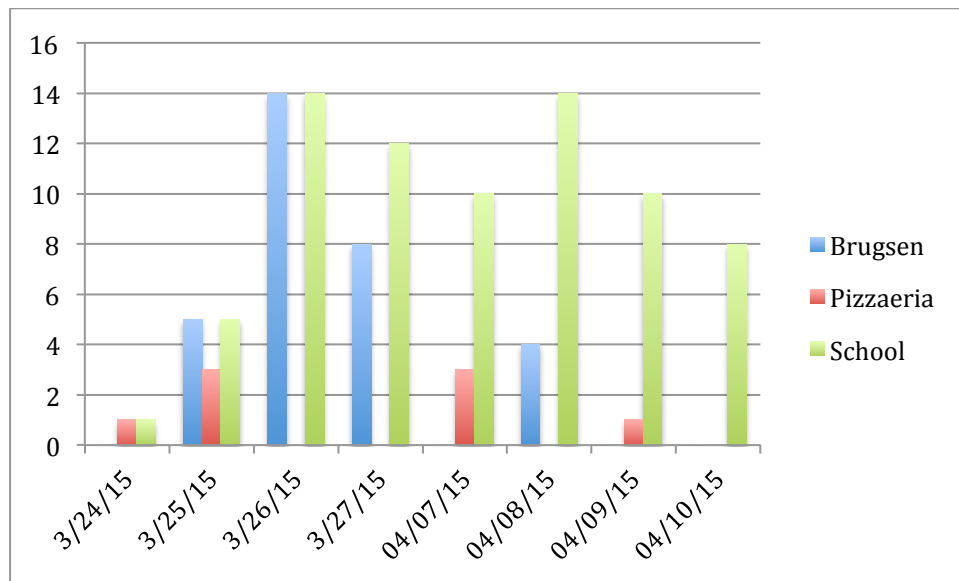
Fig 12: Frequency of students buying food from different study locations during study dates.

Additionally Fig 7, the bar chart shows total number of students tracked in three different locations during the study days. In this study, large numbers of MAC addresses were detected in school canteen (74) and than in super brugsen (31). This difference in number could be discussed in the discussion section, what factors could have affected the results.

5.2.1 Saying vs doing (Questionnaire vs tracking)
Correlations were tested using paired sample t-test between the two different binary variables tracking with going out and tracking data with leaving school during lunch time. Table 15, shows no correlation between tracking of student's MAC addresses in different locations and student's responses in questions; going out and leaving school during lunchtime.

		N	Correlation	Sig.
Pair 1	Tracking_1 & GoingOut	29	-.048	.803
Pair 2	Tracking_1 & Leaving skole in lunchtime	29	-.209	.277

Table 15: Paired Samples Correlations between Tracking data, going out and Leaving school during lunchtime

Similarly, the frequency table in table 16 shows tracking data and questionnaire

response. 14 responses were no as going out during lunchtime while their MAC addresses were not been tracked in either of locations. Similarly, 4 responses were going out from school during lunchtime and were not tracked. However, 2 MAC addresses were tracked and had responses as going out. Therefore, those 2 students saying and doing resembles which is considered as doing what they are saying. However, 9 MAC address were tracked despite of the response as not going out during lunchtime. The entire findings are discussed in the discussion section.

		Going Out	
		No	Yes
		Count	Count
Tracking_1	0	14	4
	1	9	2

Table 16: Frequency of tracking and response to going out from questionnaire

Table 17, shows the tracked MAC addresses and SMS survey responses on 26th march in different study locations. Because SMS responses was high on that date compared to other two dates. SMS responses were corresponded with tracking, it was found that 6 mobile SMS replied as they ate food bringing from home but were tracked in super brugsen's device. Similarly, one SMS saying food from home but were tracked in Rey's pizzeria. Therefore, it is not clear whether there was fault in the devices or students are not doing what they are saying.

	Super Brugsen	Canteen	No tracking	Rey's pizzeria	Total
Canteen			1		1
Home	6	5	3	1	15
No SMS Reply	1			1	2
No food	1		1		2
Pappas	1	1		1	3
Total	**9**	**6**	**5**	**3**	**23**

Table17: Pivotal table (Count of Tracking data and SMS response on different location on 26/03/2015)

6.0 Discussion:

The aim of this paper was twofold: first was to explore the availability of foodscapes around Lynge school and to examine students' foods bringing or buying place either from home or school canteen or outside food outlets. And second was to explore the feasibility and challenges of conducting tracking smartphone's MAC addresses with mobile SMS method in collecting dietary data as method. Furthermore, methodology of this study will also be shortly discussed.

6.1 Availability of food outlets in Lynge School foodscapes

From fig 4, the school's foodscapes contains two fast foods and two supermarkets and a canteen. Canteen was located inside the school. And the numbers of fast food outlets and supermarket were found in equal number, where supermarkets are considered as food outlets with healthy food choices (Stark et al., 2013). With the high economic status of Lynge region, the availability of food outlets is considered dense. School with average of 2.5 fast foods outlets in buffer of 1500m was categorized high dense cluster of fast food outlets around the school (Days & Pearce, 2011). This study resembles the finding from the study done in Denmark (Svastisalee et al., 2011) on the density of fast food around different socioeconomic status, as neighborhood in high economic has more availability of fast food outlets with supermarkets. But cannot be generalized, as this is a case study. However this shows contrasts with the other studies from Brazil (Duran et al., 2013), France (Smoyer-Tomic et al., 2008) and Australia (Inglis, 2007) as fast food outlets were more likely dense in neighbourhoods with low economic status.

6.2 Dietary habit among student

In relation to other articles, perceived locations of fast food outlets directly influence adolescent on consumption of fast foods (Days & Pearce, 2011; Burgoine et al., 2014; Svastisalee et al., 2014). But despite of high number of fast food outlets there are less likely students buy foods from fast food outlets and less consumption of fast foods. This study showed that students tend to bring foods from home. And illustrates parental education level having positive association with students bringing foods from home. Higher the Parental education level more likely students bring foods from home. Foods form home contains high in fruits and vegetables (Culter et al., 2011)

and eating out is associated with high-energy intake foods and drinks results in overweight (Bezerra et al., 2012). Therefore, educated parents are more concern about their children's food eating habits and prepare foods form home (Vereecken et al., 2004; Matthiessen et al, 2014). But mother full time employment is negatively associated with family food environment (Bauer et al., 2012). This study shows no significance with bringing food from home and parental work.

Similarly, low-grade students tend to bring food from home whereas high-grade students more likely to go out during school lunchtime. As the school policy, from 7th grades, students are allowed to leave school during lunchtime but those students tend to bring foods from home as their usual habit. Similarly, for high-grade students going out from school during lunchtime is habitual behavior doing since two years. This has also been found in tracking result that 9th graders go out more in compared to 7th grades although the number differences were not high. Similarly finding was found by SIF (2015), increasing age has influence in increasing consumption of fast foods.

Also, foods bringing from home have influence in less consumption of foods from fast food outlets located outside of the school environment in Lynge School. A study done in Denmark also found that students bringing foods from home might reduce fast food intake (Svastisalee et al., 2014). The foods brought from home were mostly sandwiches, Rice and chicken, fruits and vegetables and considered as healthy (Appendix M-survey).

There were some students buying foods from canteen compared to students going out to during lunchtime. Since canteen is located in school and all students can easily access in the canteen. Therefore it is a convenient place for students to buy food despite of any weather condition, or time limit. It is important to take into account from the dietary assessments (used in questionnaire, Appendix) in Lynge School. The foods sold in the canteen were less fruits and vegetables and selling more fast foods like, Pizza, meatballs, cakes, concentrated juices and other food items. The reason of convenience and the availability of fast foods in the school canteen might have decrease in the number of students going out during school lunchtime.

Due to selling of fast foods in the canteen might be of great concern of school administration to create policy in the canteen selling healthy foods. A study done by Neumar-s et al., (2005), also found that implementing school policies in decreasing sell of high fats and sugar inside school canteen are positively associated with less frequently purchase of those foods. Similarly, School based intervention is necessary in tackling the epidemic of childhood obesity. A Meta-analysis in school intervention among childhood obesity concluded school based intervention in long and short term are effective (Gonzalez-s et al., 2009). Therefore changing the policy in school canteen in Lynge School could be an intervention to expose students in eating healthy environment by selling more fruits and vegetables in cheap price. Municipality could also change the policy of schools to sell foods in school canteen considering as Macro level. An example implementing EAT program in schools in Copenhagen, which is run by Copenhagen Municipality in collaboration with Copenhagen food house. In every school located in Copenhagen, Food house make foods for students with variety of healthy foods. The Municipality offers foods with reduced price for low economical status students (EAT, Købehavns Madhus, 2015). Therefore, students' food buying behavior from school canteen can be consider as a problem and have to create policy in Macro level. Ecological model also emphasize on policy as its one of the determinants for intervention in eating behavior of unhealthy or fast foods from school canteen during school lunchtime (Sallis et al., 2002; Brown & Laura, 2007).

This study has not found any significance in relation to BMI and buying foods form canteen. This might be unknown whether there might be any impact on BMI due to consumption of foods from canteen. But literature shows that food consumed high in energy with low fruits and vegetables is associated with increase in BMI (Davis & Carpenter, 2009, Wang et al., 2007, Virtanen et al., 2015). Nevertheless the study is limited to a case study and limited during lunchtime. No clear information was gathered about the dietary habits of students. Therefore no relationship between food environment and BMI, which may result due to small number of participants or uncertainty in reporting in cross sectional studies (Smith et al., 2013).

6.3 MAC addresses and SMS technology in data collection:

This is the first study conducted using tracking and SMS technology in dietary data collection. This study aimed to investigate the use of smartphones in online tracking and mobile SMS receiving instant messages as data collection method in dietary assessment studies. This method is comprehended as an effective tool in collecting data to examine the human movement in large foodscapes and investigating dietary habits through instant SMS messages. But because of low data collection, it is still hypothesized that this technology might also applicable to collect data in large sampling studies (Versichele et al., 2012; Abedi et al., 2014). However this study has shown the potential and technicalities use of this method. It was found that collaborating tracking and SMS could provide lot of information about students and their dietary habits. Together this technology could investigate the reality of response received from SMS survey by comparing responses and tracking locations. As done in this study, investigating "Saying" vs "Doing".

In this study, SMS responses was hypothesized as instant behavior and considered as "Doing" an action, from the result, there was found to be difference form what students responded or said than they were detected by the tracking devices. Therefore it is important to investigate whether there was technical error or students' teenage behavior (Peper & Dahl, 2013). Some practical challenges are present below.

- Ethical consideration

Ethical consideration was taken into consideration during the study. First of all, students' name was kept anonymous. Students were known from their smartphones MAC addresses. But due to low age group of students (below 18), Parental signed informed context was essential (Christensen, 2002) and were received as voluntary participations. All the received parental signed letters were kept in safe place. But Participants can remove themself from the study by turning the Wi-Fi signals off on there mobile phones. This is important so participants can decide to be part of the study.

Teachers were asked permissions and their participations during questionnaire survey among students. In addition, teacher also reviewed the questionnaire to minimize the private information of students. Home address from the questionnaire was found more

private question for students, therefore not considered during the analysis. This could have been used to investigate students' home distance and school, which could provide the eating pattern of some students as going home during lunchtime.

But it can be discussed whether providing MAC address is an ethical issue because of its consequences in causing privacy problem. It was observed and noticed during the study that many students did not take part in this study with their own choices due to the concern about MAC address as private information. Different other studies have been conducted data with same technology as tracking MAC addresses or Bluetooth signals but without any authority or informed information to participant (Versichele et al., 2012; Abedi et al., 2014). Due the fact that it is just a serial number and every device sends these information beacons in the air every seconds and can be encrypted by tracking device (Cunche, 2014). Same study suggested not to provide owned device's MAC addresses because of the hacking risk. But still argues whether it is really a problem. Also, there has not been enough research whether it is actually an issue regarding MAC addresses that could contribute in hacking risk of information from devices.

But providing mobile number is quiet a problematic and concern among adolescence and their parents. There was found mobile associated with risk of bullying in cyber crime (Slonje & Smith, 2008).

- Strength measurement: The distance between the tracking devices and MAC addresses were not measured in this study. It could have been measured by the signal strength of the tracking MAC addresses (Abedi et al., 2014). This would have provided much more accurate data about students' presence. For instance, in this study, due to insufficient tracking device, only one device was installed in the Super Brugsen to track all the MAC addresses from different other locations (Pappas & Netto) but it was found that one of the SMS response on eating location was 26/03/2015 Pappas pizzeria but it was not tracked in the location (Super brugsen). Therefore the results from tracking and SMS surveys were biased due to the positioning of tracking devices, or student might have turned off smartphone's Wi-Fi. Similarly, tracking in canteen created difficulties during analysis. Since canteen was inside the school building near entrance and every time student passed by were

tracked. Merged time period overcome this concern but still students who stopped by to chat for more than 4 minutes near canteen were also considered as food bought from school canteen. Another advantage of strength measurement was to investigate the group behavior (Abedi et al., 2014). When students were tracked and found with the same range would considered in groups.

- Wi-Fi connection: In order to run this method and to conduct online tracking, Wi-Fi connection is necessary. This study is not possible in the places without Internet or Wi-Fi connection. During the study period on 24/03/201, there was Wi-Fi connection problem (less IP address) in the school. Consequently, less number of MAC addresses were tracked on that day and cable Internet was used instead. Likewise, in super brugsen, low Wi-Fi signal strength was an issue. It was necessary that the device had to be installed near the window to cover whole area. And the Wi-Fi strength was low. With the low signal the tracking device use to turn off and on. Shifting mode with low Wi-Fi strength caused the loss of data. It was observed the lack of Wi-Fi strength was not able to track MAC addresses. During the study period it was observed that students were in Pappas pizzeria eating pizza but their MAC addresses were not been tracked in online.

- Weather: Outdoors activities decline with the weather especially among adolescent (Bélange et al., 2009). It was found that, there is trend of bringing food from home and availability of school canteen inside school building, lowers numbers of students going out because of weather (winter or rainy) compared to summer. Weather might has affected the number of students going out during the study period. The average measured temperature in two weeks study period was around 5^0C.

- Facts: But this method is totally relying with the smartphones and no tracking occurs if the device Wi-Fi is turned off. Students have to carry smartphones every time during the study time. Despite the everyday use of the smartphones it is not necessarily compulsion to carry device every time. In this study the tracking data was low in number. This could happen because the devices could have been left in the classroom during the lunchtime or the devices were turned off (Abedi et al., 2014).

- Mobile Survey: Students were asked to provide their mobile numbers in doing questionnaire survey. But while responding the SMS survey, email accounts were used. And was difficult in transferring quantitative data from mobile SMS survey from those students used their email address. This resulted in excluding few data because of unknown MAC address from email account. Students were not fully participating in this study; this was shown when students did not reply SMS questions when they were found online in study location. This could have provided more information about the benefits of using tracking with SMS technology.

- Study duration:

It can be argued whether study time was not enough for this study with adolescence target group. There could be the reason of teenage behavior of students affected the result in data collection. Participants were teenage group and at the age of puberty (10-17 years). Behavior in these age group adolescences have been explored with the pubertal hormonal change there is change in behavior for instance with the increase testosterone level have been associated with increased approach-relates behavior as proactive aggression (Peper & Dahl, 2013). These kinds of changes in behavior due to the age could have affected this study.

There were lots of activities going on in the school during the study duration. Students were preparing for the exams and busy doing their assignments. 9th grade students had field trip Tuesday and Thursday of week 15. There was public holiday in between the study weeks 13 and 15. All these small happenings in the school during study time might have also affected the tracking results. More weeks could have provided some more data.

There had been many reviews conducted in terms of finding the right dietary assessment tools in particular and concern groups (Magarey et al., 2011). Thus tracking with SMS technological method could overcome the inaccuracy problem of self-reported traditional method (Wharton et al., 2014) and validity whether remembering food intake could affect the finding (Kolodxiejczyk et al., 2012). Similarly, with the study findings on remembering foods intake of last week was found difficult to remember among students. Therefore, SMS could provide researchers and participants an opportunity to know the foods consumed instantly.

But SMS is considered as self reported information and this could not accurately overcome the challenge of individual bias related to self-reported traditional dietary assessment tools (Illner et al., 2012). Although, this study could not show the full potential of this technology, because of some practical challenges, tracking and SMS have the potential of correlate the truthiness or reliability of reported dietary responses. And target group for this study could also be discussed whether adolescence students' behavior affected this study. However this study provided the potential of conducting tracking and SMS as method in data collection for more specific and more interested group or individuals.

Some other studies also have presented smartphones as data collection method as creating smartphone's applications (Doherty et al., 2014) that allows participants to moved out anytime they like and there is no need of any authorizations or agreement needed. Downloading dietary assessment application in smartphones might provide as useful tools in collecting dietary data and GPS is embedded in the applications (Zhu et al, 2013; Doherty et al., 2014). Every evening the alarm or message could be send to go in the apps and fill up the questions of boxes related to participants diet. Or that app could also provide the tracking among participant's everyday route.

This study has several limitations. Firstly, this is a cross sectional study limitation in itself, precluding in concluding causal association between foods from home, school or outside food outlets and gender, class and family socio-economic status. The measures were self-reported, and were categorized from the original scales due to low response rate, however this may have affected validity and reliability. Due to less significant use, some questions from the questionnaire have not been used in analysis. That could have affected the findings in other way. Additionally, findings from this study may not be possible to generalize due to low number of participants. Since this is the first study conducted using tracking and SMS technology in data collection, there was few issues concern. Therefore, the process in itself is biased in data collection operating tracking and SMS survey due to errors occurred.

7.0 Conclusion:

Despite the limitation, the presented study advances our knowledge in two different areas. One, in the filed of conducting tracking and SMS survey for future studies, the other in dietary pattern among students from Lynge School. Due to the geographical location and high economical status economical status, there were cluster of fast food outlets and convenience stores. The trend of bring foods from was found to be more among students in Lynge School. Due to the trend of brining foods form home there were less likely students go out and buy foods from outside food outlets. However, significance difference was found on students going out and gender. Boys would go out to eat during their lunchtime compared to girls. Also, grades were positively associated with food bring from home and going out to eat foods from outside food outlets. It was found 9th graders were more out during lunchtime compared to 7th. Few students would buy foods from canteen but policy is need from school administration to sell more fruits and vegetables and less high-energy dense food.

This study provided a different approach of data collection in dietary studies. However in this study, the data collection through tracking and SMS survey was not fully accomplished because of some practical issues and there was found some concern about the students' behavior. But this method was found more effective in examining the reliability of response from the participants by testing saying vs. doing using tracking technology. But conducting this study has shown the potential benefits in data collection using tracking device and SMS survey in low budget. More research is needed to validate tracking and SMS technology as method in dietary data collection.

7.1 Future implementation

This study has provided ideas and in-depth benefits and consequences in using tracking and SMS technologies. There has less evidence of using this method in other setting. This method could be more valuable for future research conducting using tracking technology in dietary data collection. Further investigation in different settings using tracking and SMS technology would provide the validity and reliability of using this as data collection method in dietary data collection.

This paper also highlights the eating pattern of students in Lynge School. Although more students bring foods from home, canteen was the conveniences place for buying food among students. This study has enlightened the foods sold in the canteen, which could be seen as problem among students. Hence, implementing policy in macro level in school institution for administrator or Municipality could improvise the present system.

Literature

1) EAT - a school lunch concept - Københavns Madhus UK . Available: http://en.kbhmadhus.dk/eat/eat-a-school-lunch-concept [2015, 6/3/2015].

2) HBSC-Rapport-2014.pdf . Available: http://www.hbsc.dk/downcount/HBSC-Rapport-2014.pdf [2015, 5/18/2015].

3) Healthy Weight: Assessing Your Weight: BMI: About BMI for Children and Teens | DNPAO | CDC . Available: http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html [2015, 6/3/2015].

4) MAC Addressing - Introduction to the MAC Address . Available: http://compnetworking.about.com/od/networkprotocolsip/l/aa062202a.htm [2015, 5/9/2015].

5) Municipalities and regions: Key Figures - Statistics Denmark . Available: http://www.dst.dk/en/Statistik/emner/kommuner-og-regioner.aspx [2015, 5/9/2015].

6) Abedi, N., Bhaskar, A. & Chung, E. 2014, "Tracking spatio-temporal movement of human in terms of space utilization using Media-Access-Control address data", Applied Geography, vol. 51, pp. 72-81.

7) Abedi, N., Bhaskar, A. & Chung, E. 2013, "Bluetooth and Wi-Fi MAC address based crowd data collection and monitoring: benefits, challenges and enhancement", .

8) Bandura, A. 2001, "Social cognitive theory: An agentic perspective", Annual Review of Psychology, vol. 52, no. 1, pp. 1-26.

9) Bélanger, M., Gray-Donald, K., O'loughlin, J., Paradis, G. & Hanley, J. 2009, "Influence of weather conditions and season on physical activity in adolescents", Annals of Epidemiology, vol. 19, no. 3, pp. 180-186.

10) Bezerra, I.N., Curioni, C. & Sichieri, R. 2012, "Association between eating out of home and body weight", Nutrition reviews, vol. 70, no. 2, pp. 65-79.

11) Bonham-Carter, G.F. 2014, Geographic information systems for geoscientists: modelling with GIS, Elsevier.

12) Brock, S. & Nielsen, N.K. 2009, Børns spisevaner: En undersøgelse omkring 4.og 6.klasse, .

13) Casey, R., Oppert, J., Weber, C., Charreire, H., Salze, P., Badariotti, D., Banos, A., Fischler, C., Hernandez, C.G. & Chaix, B. 2014, "Determinants of childhood obesity: What can we learn from built environment studies?", Food Quality and Preference, vol. 31, pp. 164-172.

14) Chen, S.E., Florax, R.J. & Snyder, S.D. 2013, "Obesity and fast food in urban markets: a new approach using geo-referenced micro data", Health Economics, vol. 22, no. 7, pp. 835-856.

15) Christensen, L.M., Kørup, K., Trolle, E., Matthiessen, J. & Fagt, S. 2013, Børn og unges måltidsvaner 2005-2008, .

16) Christensen, P. & Prout, A. 2002, "Working with ethical symmetry in social research with children", Childhood, vol. 9, no. 4, pp. 477-497.

17) Cummins, S., Flint, E. & Matthews, S.A. 2014, "New neighborhood grocery store increased awareness of food access but did not alter dietary habits or obesity", Health affairs (Project Hope), vol. 33, no. 2, pp. 283-291.

18) Cunche, M. 2014, "I know your MAC Address: Targeted tracking of individual using Wi-Fi", Journal of Computer Virology and Hacking Techniques, vol. 10, no. 4, pp. 219-227.

19) Cutler, G.J., Flood, A., Hannan, P. & Neumark-Sztainer, D. 2011, "Multiple sociodemographic and socioenvironmental characteristics are correlated with major patterns of dietary intake in adolescents", Journal of the American Dietetic Association, vol. 111, no. 2, pp. 230-240.

20) Davis, B. & Carpenter, C. 2009, "Proximity of fast-food restaurants to schools and adolescent obesity", American Journal of Public Health, vol. 99, no. 3, pp. 505-510.

21) Day, P.L. & Pearce, J. 2011, "Obesity-promoting food environments and the spatial clustering of food outlets around schools", American Journal of Preventive Medicine, vol. 40, no. 2, pp. 113-121.

22) Doherty, S.T., Lemieux, C.J. & Canally, C. 2014, "Tracking human activity and well-being in natural environments using wearable sensors and experience sampling", Social science & medicine, vol. 106, pp. 83-92.

23) Drewnowski, A., Moudon, A.V., Jiao, J., Aggarwal, A., Charreire, H. & Chaix, B. 2014, "Food environment and socioeconomic status influence obesity rates in Seattle and in Paris", International journal of obesity, vol. 38, no. 2, pp. 306-314.

Duran, A.C., Roux, A.V.D., Maria do Rosario, D. & Jaime, P.C. 2013, "Neighborhood socioeconomic characteristics and differences in the availability of healthy food stores and restaurants in Sao Paulo, Brazil", Health & place, vol. 23, pp. 39-47.

24) Entwislea, D.R. & Astone, N.M. 1994, "Some practical guidelines for measuring youth's race/ethnicity and socioeconomic status", Child development, vol. 65, no. 6, pp. 1521-1540.

25) Fleischhacker, S., Evenson, K., Rodriguez, D. & Ammerman, A. 2011, "A systematic review of fast food access studies", Obesity Reviews, vol. 12, no. 5, pp. e460-e471.

26) Fox, M.K., Gordon, A., Nogales, R. & Wilson, A. 2009, "Availability and consumption of competitive foods in US public schools", Journal of the American Dietetic Association, vol. 109, no. 2, pp. S57-S66.

27) Fraser, L.K., Edwards, K.L., Cade, J. & Clarke, G.P. 2010, "The geography of fast food outlets: a review", International journal of environmental research and public health, vol. 7, no. 5, pp. 2290-2308.

28) Gonzalez-Suarez, C., Worley, A., Grimmer-Somers, K. & Dones, V. 2009, "School-based interventions on childhood obesity: a meta-analysis", American Journal of Preventive Medicine, vol. 37, no. 5, pp. 418-427.

29) Griffiths, C., Frearson, A., Taylor, A., Radley, D. & Cooke, C. 2014, "A cross sectional study investigating the association between exposure to food outlets and childhood obesity in Leeds, UK", The international journal of behavioral nutrition and physical activity, vol. 11, pp. 138-014-0138-4.

30) Guenther, P.M., Kirkpatrick, S.I., Reedy, J., Krebs-Smith, S.M., Buckman, D.W., Dodd, K.W., Casavale, K.O. & Carroll, R.J. 2014, "The Healthy Eating Index-2010 is a valid and reliable measure of diet quality according to the 2010 Dietary Guidelines for Americans", The Journal of nutrition, vol. 144, no. 3, pp. 399-407.

31) Gyurak, A., Gross, J.J. & Etkin, A. 2011, "Explicit and implicit emotion regulation: a dual-process framework", Cognition and Emotion, vol. 25, no. 3, pp. 400-412.

32) Harris, D.E., Blum, J.W., Bampton, M., O'Brien, L.M., Beaudoin, C.M., Polacsek, M. & O'Rourke, K.A. 2011, "Location of food stores near schools does not predict the weight status of Maine high school students", Journal of nutrition education and behavior, vol. 43, no. 4, pp. 274-278.

33) He, M., Tucker, P., Gilliland, J., Irwin, J.D., Larsen, K. & Hess, P. 2012, "The influence of local food environments on adolescents' food purchasing behaviors", International journal of environmental research and public health, vol. 9, no. 4, pp. 1458-1471.

32) He, M., Tucker, P., Irwin, J.D., Gilliland, J., Larsen, K. & Hess, P. 2012, "Obesogenic neighbourhoods: the impact of neighbourhood restaurants and convenience stores on adolescents' food consumption behaviours", Public health nutrition, vol. 15, no. 12, pp. 2331-2339.

33) Hiza, H., Guenther, P. & Rihane, C. 2013, "Diet quality of children age 2-17 years as measured by the Healthy Eating Index-2010", Nutr Insight, vol. 52.

34) Höhn, J., Lehtonen, E., Rasi, S. & Rintala, J. 2014, "A Geographical Information System (GIS) based methodology for determination of potential biomasses and sites for biogas plants in southern Finland", Applied Energy, vol. 113, pp. 1-10.

35) Holsten, J.E., Deatrick, J.A., Kumanyika, S., Pinto-Martin, J. & Compher, C.W. 2012, "Children's food choice process in the home environment. A qualitative descriptive study", Appetite, vol. 58, no. 1, pp. 64-73.

36) Huang, Y., Chapman, P. & Evans, D. 2011, "Privacy-Preserving Applications on Smartphones.", HotSec.

37) Illner, A.K., Freisling, H., Boeing, H., Huybrechts, I., Crispim, S.P. & Slimani, N. 2012, "Review and evaluation of innovative technologies for measuring diet in nutritional epidemiology", International journal of epidemiology, vol. 41, no. 4, pp. 1187-1203.

38) Kolodziejczyk, J.K., Merchant, G. & Norman, G.J. 2012, "Reliability and validity of child/adolescent food frequency questionnaires that assess foods and/or food groups", Journal of pediatric gastroenterology and nutrition, vol. 55, no. 1, pp. 4-13.

39) Kopelman, P. 2007, "Health risks associated with overweight and obesity", Obesity reviews, vol. 8, no. s1, pp. 13-17.

40) Kremers, S.P., de Bruijn, G.J., Visscher, T.L., van Mechelen, W., de Vries, N.K. & Brug, J. 2006, "Environmental influences on energy balance-related behaviors: a dual-process view", The international journal of behavioral nutrition and physical activity, vol. 3, pp. 9.

41) Krömker, D., Stolberg, A., Müller, C., Tian, Z. & Parlesak, A. 2015, "Is Adolescent Body Weight Associated With Parental Beliefs About Overweight, Attitudes Towards Food, and the Home Environment?", Journal of Food Research, vol. 4, no. 2, pp. p104.

42) Lakshman, R., Elks, C.E. & Ong, K.K. 2012, "Childhood obesity", Circulation, vol. 126, no. 14, pp. 1770-1779.

43) Laska, M.N., Hearst, M.O., Forsyth, A., Pasch, K.E. & Lytle, L. 2010, "Neighbourhood food environments: are they associated with adolescent dietary intake, food purchases and weight status?", Public health nutrition, vol. 13, no. 11, pp. 1757-1763.

44) Lubans, D.R., Plotnikoff, R.C., Morgan, P.J., Dewar, D., Costigan, S. & Collins, C.E. 2012, "Explaining dietary intake in adolescent girls from disadvantaged secondary schools. A test of Social Cognitive Theory", Appetite, vol. 58, no. 2, pp. 517-524.

45) Lyseen, A.K., Hansen, H.S., Harder, H., Jensen A. S. & Mikkelsen, B. E., 2015, "Defining Neighbourhoods as a Measure of Exposure to the Food Environment. Aalborg University, Denmark.

46) MacKendrick, N. 2014, "Foodscape", Contexts, vol. 13, no. 3, pp. 16-18.

47) Matthiessen, J., Stockmarr, A., Fagt, S., Knudsen, V.K. & Biltoft-Jensen, A. 2014, "Danish children born to parents with lower levels of education are more likely to become overweight", Acta Paediatrica, vol. 103, no. 10, pp. 1083-1088.

48) McAlister, A.L., Perry, C.L. & Parcel, G.S. 2008, "How individuals, environments, and health behaviors interact", HEALTH BEHAVIOR, vol. 169.

49) Mikkelsen, B.E. 2011, "Images of foodscapes: introduction to foodscape studies and their application in the study of healthy eating out-of-home environments", Perspectives in public health, vol. 131, no. 5, pp. 209-216.

50) Morland, K., Roux, A.V.D. & Wing, S. 2006, "Supermarkets, other food stores, and obesity: the atherosclerosis risk in communities study", American Journal of Preventive Medicine, vol. 30, no. 4, pp. 333-339.

51) Neumark-Sztainer, D., French, S.A., Hannan, P.J., Story, M. & Fulkerson, J.A. 2005, "School lunch and snacking patterns among high school students: associations with school food environment and policies", The international journal of behavioral nutrition and physical activity, vol. 2, no. 1, pp. 14.

52) Nordic Council of Ministers 2014, Nordic Nutrition Recommendations 2012, Organisation for Economic Co-operation and Development.

53) Ogden, C.L., Carroll, M.D., Kit, B.K. & Flegal, K.M. 2014, "Prevalence of childhood and adult obesity in the United States, 2011-2012", Jama, vol. 311, no. 8, pp. 806-814.

54) Ogden, C.L., Carroll, M.D., Kit, B.K. & Flegal, K.M. 2012, "Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010", Jama, vol. 307, no. 5, pp. 483-490.

55) Oulasvirta, A., Rattenbury, T., Ma, L. & Raita, E. 2012, "Habits make smartphone use more pervasive", Personal and Ubiquitous Computing, vol. 16, no. 1, pp. 105-114.

56) Pampel, F.C., Krueger, P.M. & Denney, J.T. 2010, "Socioeconomic Disparities in Health Behaviors", Annual review of sociology, vol. 36, pp. 349-370.

57) Papoutsi, G.S., Drichoutis, A.C. & Nayga, R.M. 2013, "The causes of childhood obesity: A survey", Journal of Economic Surveys, vol. 27, no. 4, pp. 743-767.

58) Pei, L., Guinness, R., Chen, R., Liu, J., Kuusniemi, H., Chen, Y., Chen, L. & Kaistinen, J. 2013, "Human behavior cognition using smartphone sensors", Sensors, vol. 13, no. 2, pp. 1402-1424.

59) Peper, J.S. & Dahl, R.E. 2013, "The teenage brain surging hormones—brain-behavior interactions during puberty", Current directions in psychological science, vol. 22, no. 2, pp. 134-139.

60) Powell, L.M. & Han, E. 2011, "Adult obesity and the price and availability of food in the United States", American Journal of Agricultural Economics, , pp. aaq106.

61) Richardson, A.S., Meyer, K.A., Howard, A.G., Boone-Heinonen, J., Popkin, B.M., Evenson, K.R., Kiefe, C.I., Lewis, C.E. & Gordon-Larsen, P. 2014, "Neighborhood socioeconomic status and food environment: A 20-year longitudinal latent class analysis among CARDIA participants", Health & place, vol. 30, pp. 145-153.

62) Richardson, A.S., Boone-Heinonen, J., Popkin, B.M. & Gordon-Larsen, P. 2011, "Neighborhood fast food restaurants and fast food consumption: a national study", BMC public health, vol. 11, pp. 543-2458-11-543.

63) Roche, E., Conner, D., Kolodinsky, J.M., Buckwalter, E., Berlin, L. & Powers, A. 2012, "Social cognitive theory as a framework for considering farm to school programming", Childhood Obesity (Formerly Obesity and Weight Management), vol. 8, no. 4, pp. 357-363.

64) Sallis, J.F., Cervero, R.B., Ascher, W., Henderson, K.A., Kraft, M.K. & Kerr, J. 2006, "An ecological approach to creating active living communities", Annu.Rev.Public Health, vol. 27, pp. 297-322.

65) Salvy, S., De La Haye, K., Bowker, J.C. & Hermans, R.C. 2012, "Influence of peers and friends on children's and adolescents' eating and activity behaviors", Physiology & Behavior, vol. 106, no. 3, pp. 369-378.

66) Sattler, M., Hopkins, L., Anderson Steeves, E., Cristello, A., Mccloskey, M., Gittelsohn, J. & Hurley, K. 2015, "Characteristics of Youth Food Preparation in Low-Income, African American Homes: Associations with Healthy Eating Index Scores", Ecology of Food and Nutrition, , no. ahead-of-print, pp. 1-17.

67) Schreier, H. & Chen, E. 2013, "Socioeconomic status and the health of youth: A multilevel, multidomain approach to conceptualizing pathways.", Psychological bulletin, vol. 139, no. 3, pp. 606.

68) Sheeran, P., Gollwitzer, P.M. & Bargh, J.A. 2013, "Nonconscious processes and health.", Health Psychology, vol. 32, no. 5, pp. 460.

69) Slonje, R. & Smith, P.K. 2008, "Cyberbullying: Another main type of bullying?", Scandinavian Journal of Psychology, vol. 49, no. 2, pp. 147-154.

70) Smith, D., Cummins, S., Clark, C. & Stansfeld, S. 2013, "Does the local food environment around schools affect diet? Longitudinal associations in adolescents attending secondary schools in East London", BMC public health, vol. 13, pp. 70-2458-13-70.

71) Smith, J.J., Morgan, P.J., Plotnikoff, R.C., Dally, K.A., Salmon, J., Okely, A.D., Finn, T.L. & Lubans, D.R. 2014, "Smart-phone obesity prevention trial for adolescent boys in low-income communities: the ATLAS RCT", Pediatrics, vol. 134, no. 3, pp. e723-31.

72) Smoyer-Tomic, K.E., Spence, J.C., Raine, K.D., Amrhein, C., Cameron, N., Yasenovskiy, V., Cutumisu, N., Hemphill, E. & Healy, J. 2008, "The association between neighborhood socioeconomic status and exposure to supermarkets and fast food outlets", Health & place, vol. 14, no. 4, pp. 740-754.

73) Stark, J.H., Neckerman, K., Lovasi, G.S., Konty, K., Quinn, J., Arno, P., Viola, D., Harris, T.G., Weiss, C.C., Bader, M.D. & Rundle, A. 2013, "Neighbourhood food environments and body mass index among New York City adults", Journal of epidemiology and community health, vol. 67, no. 9, pp. 736-742.

74) Story, M., Kaphingst, K.M., Robinson-O'Brien, R. & Glanz, K. 2008, "Creating healthy food and eating environments: policy and environmental approaches", Annu.Rev.Public Health, vol. 29, pp. 253-272.

75) Story, M., Neumark-Sztainer, D. & French, S. 2002, "Individual and environmental influences on adolescent eating behaviors", Journal of the American Dietetic Association, vol. 102, no. 3, pp. S40-S51.

76) Streletskaya, N.A. & Kaiser, H.M. 2014, "Reply to Comment on Taxes, Subsidies, and Advertising Efficacy in Changing Eating Behavior: An Experimental Study", Applied Economic Perspectives and Policy, vol. 36, no. 4, pp. 722-726.

77) Svastisalee, C.M., Nordahl, H., Glümer, C., Holstein, B.E., Powell, L.M. & Due, P. 2011, "Supermarket and fast-food outlet exposure in Copenhagen: associations with socio-economic and demographic characteristics", Public health nutrition, vol. 14, no. 09, pp. 1618-1626.

78) Svastisalee, C., Schipperijn, J., Jørgensen, S.E., Pedersen, T.P. & Krølner, R. 2014, "Fast food intake among adolescents and measures of fast food outlet exposure: cross-sectional study in Denmark", The European Journal of Public Health, vol. 24, no. suppl 2, pp. cku165. 134.

79) Tirosh, A., Shai, I., Afek, A., Dubnov-Raz, G., Ayalon, N., Gordon, B., Derazne, E., Tzur, D., Shamis, A. & Vinker, S. 2011, "Adolescent BMI trajectory and risk of diabetes versus coronary disease", New England Journal of Medicine, vol. 364, no. 14, pp. 1315-1325.

80) Vereecken, C.A., Keukelier, E. & Maes, L. 2004, "Influence of mother's educational level on food parenting practices and food habits of young children", Appetite, vol. 43, no. 1, pp. 93-103.

81) Versichele, M., Neutens, T., Delafontaine, M. & Van de Weghe, N. 2012, "The use of Bluetooth for analysing spatiotemporal dynamics of human movement at mass events: A case study of the Ghent Festivities", Applied Geography, vol. 32, no. 2, pp. 208-220.

82) Virtanen, M., Kivimaki, H., Ervasti, J., Oksanen, T., Pentti, J., Kouvonen, A., Halonen, J.I., Kivimaki, M. & Vahtera, J. 2015, "Fast-food outlets and grocery stores near school and adolescents' eating habits and overweight in Finland", European journal of public health, .

83) Wang, M.C., Kim, S., Gonzalez, A.A., MacLeod, K.E. & Winkleby, M.A. 2007, "Socioeconomic and food-related physical characteristics of the neighbourhood environment are associated with body mass index", Journal of epidemiology and community health, vol. 61, no. 6, pp. 491-498.

84) Wharton, C.M., Johnston, C.S., Cunningham, B.K. & Sterner, D. 2014, "Dietary self-monitoring, but not dietary quality, improves with use of smartphone app technology in an 8-week weight loss trial", Journal of nutrition education and behavior, vol. 46, no. 5, pp. 440-444.

85) Yoon, H. & Tourassi, G. 2014, "Analysis of online social networks to understand information sharing behaviors through social cognitive theory", Biomedical Science and Engineering Center Conference (BSEC), 2014 Annual Oak Ridge National LaboratoryIEEE, , pp. 1.

86) Zhu, X., Li, Q. & Chen, G. 2013, "APT: Accurate outdoor pedestrian tracking with smartphones", INFOCOM, 2013 Proceedings IEEEIEEE, , pp. 2508.